Laborastories:

Creative Assessment for NCEA Science

A thesis

submitted in partial fulfilment

of the requirements for the Degree of

Master of Science Communication

at

University of Otago

by

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University of Otago

2020

Abstract of a thesis submitted in partial fulfilment of the requirements for the Degree of Master of Science Communication.

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The National Certificate of Educational Achievement (NCEA) is the main form of assessment used in New Zealand secondary schools. This system promotes fragmentation of knowledge and does not align with the values of the New Zealand Curriculum, (NZC) that learning should not be confined by subject boundaries. There is evidence to suggest that integration of subject areas can improve NCEA achievement for students, and that use of stories in school science courses can enhance engagement. The aim of this research was to find out if science teachers are interested in using storytelling as a vehicle for learners to present their understanding in NCEA science courses, and what professional development is needed to help them do this. A mixed methods approach was employed, consisting of an online questionnaire distributed to NCEA science teachers in New Zealand and 13 semi-structured interviews with individual science teachers. I found that there is interest amongst the teaching community in storytelling for creative assessment but there are significant barriers to this, most commonly: unwillingness of other people, time constraints, and increased workload for both teachers and students. Teachers with previous experience in creative and/or cross-curricular assessment methods were more open to using storytelling techniques and less negatively impacted by potential barriers to these methods. Teachers identified collaboration with other teachers, ready-made resources, and time as their most pressing needs for implementation of creative assessment methods. These findings were used to inform the creative project of this thesis: two podcasting workshops for teachers and a website, www.laborastories.nz, providing resources, opportunities for collaboration, and advice for teachers interested in using storytelling for creative NCEA science assessment.

Acknowledgements

I would first like to thank my thesis supervisor, Professor Lloyd Spencer Davis of the Centre for Science Communication, at the University of Otago. His expertise and honesty were always much appreciated and his determination for me to produce my best work at every stage of this process enabled me to present this thesis to a standard of which I can be proud.

I would also like to acknowledge the support and guidance provided by Professor Nancy Longnecker and Steve Ting, both of the Centre for Science Communication. The many conversations over my years of study provided both practical advice and pastoral care. For this I am truly grateful.

My colleagues at Otago Boys' High School deserve more than a passing mention in thanks. From senior management repeatedly agreeing to support my requests for time, money, and freedom to try new strategies with my classes; to my teaching colleagues who gave up their time to answer my questions, convince their friends to participate in my research, and take my Year 9 Science class last period on a Tuesday for an entire term so that I could attend class at university. This would not have been possible without their help. Special thanks to Mr Tony Gabbusch who, sadly, passed away as I was finishing this thesis. He kindly gave up his time (and departmental resources) to help me when I was first learning to podcast. Without his guidance, there would have been no podcasting workshops for our colleagues, and no guide to podcasting on Laborastories.nz.

Also, my wonderful family. To my parents for providing such a stellar example of teaching with the best interests of their learners in mind. My sisters Bec and Vic for years of moral support and encouragement. And my sister Allie and her husband Alan, who went above and beyond to help with "professional development" over Zoom before everyone was using it, and technical support with Laborastories.nz to make it look just the way I wanted it to. Thank you all.

Finally, my husband Ben, who has been such a vital part of this whole journey from its very beginning. For providing a listening ear and appropriately timed "yeah" when I got on a roll about my research, making sure I was fed every time I stayed late at the library, and appearing in more horribly produced assignment-related films than anyone should ever have to. I couldn't have done any of this without your love and support. Thank you, a million times.

Finishing is better than starting.
Patience is better than pride.
—Ecclesiastes 7:8

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Introduction

Education in New Zealand is in the midst of significant changes. Currently, the National Certificate of Educational Achievement (NCEA)—the country's major qualification for senior secondary school students—is under review and the proposed changes for science education are dramatic. Gone is the focus on memorising and regurgitating content, to be replaced by skills in conducting and reporting on science investigations; and evaluating and communicating science information. The divisions between subjects are blurring. Skills that were once confined to the "arts" such as use of design principles and narrative are now encouraged across all courses. As technology advances, increasing numbers of schools are shifting to a BYOD (Bring Your Own Device) model of teaching and learning. To add to this, a global pandemic has interrupted the "normal" face-to-face interactions education is centred around and every teacher has had to adapt to taking their programmes online. None of this is a simple shift for teachers and they need help to keep up. Professional development is vital for the evolution of education in line with changes in the world.

Use of stories is an effective way to communicate scientific information (Gilbert, Hipkins, & Cooper, 2005). Science teachers are well aware of this and many use this strategy extensively to engage their learners. Stories make science engaging (Avraamidou & Osborne, 2009; Vrasidas, Avraamidou, Theodoridou, Themistokleous, & Panaou, 2015), give structure to organise information (Bruner, 1991), encourage connection with content (Bedford, 2001), and can help to acknowledge cultural values of minoritized groups in classrooms (Tolbert, 2015). A less common practice is to teach students to be the storytellers in science. As pointed out by Hipkins, (2014) the content we assess determines the content we teach. If we can change the way we assess science (as the current Review of Achievement Standards aims to do) we can change the way our students learn it. By incorporating storytelling and skills from across the curriculum into assessment tasks, teachers can make science more accessible and more enjoyable for their students (and for themselves).

There is plenty of evidence to support using integration in curriculum delivery and assessment, but it is still not a widely used practice (Bonne & MacDonald, 2019). One of the reasons for this is that there is, "very little formal professional development for curriculum integration available." (Arrowsmith & Wood, 2015, p. 62). Unfortunately, much of the professional development that is on offer misses the mark. If it lacks the key ingredients of purpose, skills, reinforcement, and role-modelling as outlined by Lawson and Price (2003), (cited in Osbourne, 2014) it is a waste of a teacher's most precious commodity: time. Teaching is a demanding profession and time must be budgeted carefully to address the most pressing issues each day. Investing in time out of the classroom (or merely away from the pile of marking and pastoral responsibilities) cannot be taken

lightly. Good teacher education is optional and caters to the individual needs of participants, with the promise of ongoing support as and when needed (Arrowsmith & Wood, 2015). As Osbourne (2014), summarising the research of Robinson, Lloyd and Rowe (2008) puts it, "… if the goal is to raise student achievement, working alongside teachers to improve the quality of teaching offered to students has an effect size three times that of solely focussing on providing inspiration and motivation." (p. 6). Informal mentoring online with communities of professionals who are geographically isolated from one another is an effective mode of achieving this (Clutterbuck, 2004).
This raises the question: what do teachers need to take the plunge and encourage their students to use skills from across the curriculum to show what they understand in science? The purpose of the academic component of this thesis was to determine the level of interest amongst NCEA science teachers in using storytelling and creative assessment methods, with the possibility of combining standards across subjects with their classes. What the research showed is that there are teachers who are interested in innovating in their assessment practices, but there are several barriers standing in their way. The most significant of these are other people, time, and workload.

Informed entirely by the results of the research, two forms of professional development were created for teachers: small-group podcasting workshops and a website, http://laborastories.nz/. The workshops were held three weeks apart as part of the regular professional development programme at a school in Dunedin, New Zealand. Participants opted into the workshops and were given one-on-one support to develop their skills at making their own podcast and using podcasting as a form of assessment with their classes. Ongoing support was also offered, and participants were encouraged to work on their podcasts outside of the allotted professional development time, in line with the recommendations of Arrowsmith and Wood, (2015). Every aspect of the website was designed to address the needs expressed by teachers in the questionnaires and interviews conducted for the academic research. This was achieved by providing: free, printable resources for use with students; ideas for activities to use in class; tips and advice for how to use resources and manage collection of assessment material; a full guide to podcasting to use personally or print and use with classes; two assessment unit plans including generic task sheets to be adapted for individual teachers, extra resources, links to external sites for further ideas, sound effects and music; the opportunity to connect and collaborate with me and other teachers through the email contact section. My role in administering this website is to act as an informal mentor to teachers who visit the site, providing extra advice and support as needed, in line with the recommendations of Clutterbuck, (2004).

Education is a dynamic system, driven by changes in the outside world. Advances in technology, knowledge, and pedagogy provide plenty for teachers to stay on top of, and it can be overwhelming.

But it is vital that teachers have the skills to change their approach to teaching and learning in response to the needs of their learners. It is not realistic to divide the world into subject-titled boxes, nor is it sensitive to the cultural beliefs or abilities of many of the students in our classes. For assessment to be fair, every learner needs to have the opportunity to succeed and teachers need to be able to work with their strengths to do this. This is why targeted professional development is so important. Teachers are willing to change their practices, but they need the right help to do it. Creative assessment methods have the potential to be immensely rewarding for both teachers and learners and with the proposed changes to NCEA, they will become the norm. The current world crisis of the Covid-19 pandemic further highlights how vital it is that our learners can understand and communicate science effectively.

Part One of this thesis focuses on the benefits of integrated learning and assessment. The academic research, consisting of an online questionnaire and semi-structured interviews, addresses the three key questions:

1. *What do teachers think about cross-curricular assessment of science and arts in NCEA?*
2. *What are the barriers to assessing more than one standard with a single project?*
3. *What do teachers need to overcome barriers to be able to use cross-curricular assessment for science and arts in NCEA?*

Part Two, the creative component, consists of two podcasting workshops and a website www.laborastories.nz, designed to meet the needs expressed by teachers in order to be able to implement innovative practices with their learners.

Part One: Academic Component

Chapter 1: Literature Review

1.1 Introduction

New Zealand's secondary school system is a source of much debate regarding its unconventional structure (e.g. Granshaw & Hall, 2017; Munro, 2018). There are several contributing factors, but the major culprit is the qualification most students leave school with, the National Certificate of Educational Achievement (NCEA). On the surface, it sounds like a great idea: to split subjects into standards and give each student a record of achievement that shows exactly where their strengths and weaknesses lie. Unfortunately, it is not quite so straightforward.

New Zealand schools are expected to design their programmes of learning around the New Zealand Curriculum (NZC) and/or Te Marautanga o Aotearoa, (TMoA) the Māori medium curriculum. Released in 2007, this document invited a change in approach to education in New Zealand. The previous model, The New Zealand Curriculum Framework (NZCF) was divided into eight highly prescriptive documents (one for each subject area) and served as a manual for teachers. The NZC encourages more flexibility for programme design and places emphasis on the skills and competencies learners should develop during their time at school, in response to rapid advances in technology and societal expectations both in New Zealand and internationally. It covers the entire educational journey from new entrant to school leaver, divided into eight levels of difficulty and eight "learning areas": English, the arts, health and physical education, learning languages, mathematics and statistics, science, social sciences, and technology (Ministry of Education, 2006, p. 16).

Fundamental to this document is "…a vision for our young people as lifelong learners who are confident and creative, connected and actively involved." (Ministry of Education, 2006, p. 4). So how do we know as educators that we are instilling this vision in our young people? We assess them. According to the NZC, "The primary purpose of assessment is to improve students' learning and teachers' teaching as both student and teacher respond to the information it provides." (Ministry of Education, 2006, p. 39). That is all very well, but somewhere along the line we need to know whether students have acquired the skills necessary to survive out there in the real world. The NZC has plenty to say about the characteristics of effective assessment but gives little guidance on how this should be carried out. For this reason, we have the New Zealand Qualifications Framework (NZQF) and NCEA.

The NZQF is designed to give all learners in New Zealand—not just school students—certification for their skills and abilities in a variety of settings (NZQA, 2016). These qualifications are divided into eight levels: Level 1 is usually completed in Year 11 of schooling, and Level 8 equates to a doctoral degree. While both the NZC and the NZQF comprise eight levels, unfortunately, these levels do not correlate. Level 1 of the NZQF comes in at approximately Level 6 of the NZC.

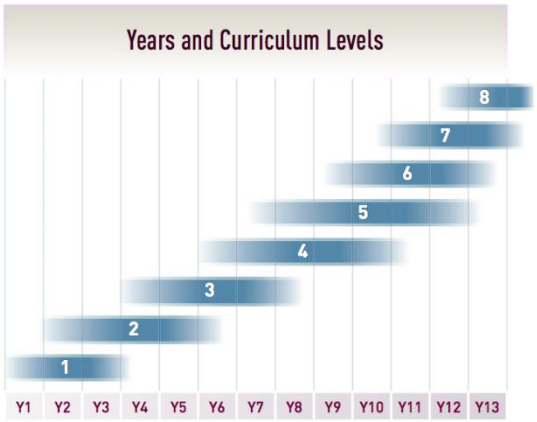

Figure 1. Alignment of NZC levels and years of schooling (Ministry of Education, 2017).

NCEA has been the system of assessment associated with the first three levels of the NZQF since 2002 (New Zealand Qualifications Authority, n.d.). From 1981, The New Zealand Employers Federation had argued that assessment of students against standards would be a far more suitable exercise (Lennox, 2001). Grading students based on their achievement compared to their peers—as was the practice in the previous system—was neither fair nor informative. Eventually, the project "Achievement 2001" was established in 1997 to develop a new system of assessment (New Zealand Qualifications Authority, n.d.). This system is what we now know as NCEA, and operates thus:

- Levels 1, 2, and 3 of NCEA align with school years 11, 12, and 13, respectively (exceptional students may also participate in the scholarship exams, which sit at Level 4).
- Each subject is divided into several standards, demonstrating a skill or area of knowledge. Each subject area usually covers five or six of these in one year.
- Each standard is worth a given number of credits, usually ranging from 3 to 6 (although there are some exceptions to this) and a typical course offers 18-24 credits in a year.
- The grades available for each standard are: Not Achieved, Achieved, Merit and Excellence (N, A, M, E). Regardless of the pass grade, the credits earned for a standard are the same (i.e. Excellence is not worth more credits than Achieved).
- Standards are assessed in one of two ways: external assessment (usually an exam) or internal assessment. Exams written by a select panel of experts take place in November and are supervised by invigilators not affiliated with the school. Internally assessed standards are

completed under the supervision of the classroom teacher and may take any form deemed appropriate. The teaching staff are responsible for developing and marking these assessments and each school has processes in place to ensure grades are consistent with the NZQA guidelines.

- To "pass" Level 1 students need to achieve 80 credits in total, with 10 credits in standards assessing each of literacy and numeracy. Levels 2 and 3 require 60 credits, with 20 credits able to be carried over from the previous year.
- Students do not pass or fail individual subjects, but they are able to gain an endorsement with either Excellence or Merit if they achieve 14 credits in one subject with a mix of internal and external standards.
- Course endorsements are also attainable, if a student gains 50 credits at Excellence or Merit across all subjects.
- University Entrance (UE) can be gained from NCEA Level 3 by achievement of 14 credits in each of three approved subjects, provided the student has already met the literacy and numeracy requirements from Level 1.

(New Zealand Qualifications Authority, 2018)

Following the introduction of the "new" NZC in 2007, NCEA underwent a realignment in which all standards were re-written to better reflect the NZC's vision. These changes were rolled out from 2011-2013 in Levels 1-3 respectively (New Zealand Qualifications Authority, n.d.). Although the intent was to embrace the NZC and provide a qualification that demonstrates the ability of each student to function as a well-rounded individual, the reality proved to be quite different. At the core of the NZC is integration across the learning areas: "While the learning areas are presented as distinct, this should not limit the ways in which schools structure the learning experiences offered to students." (Ministry of Education, 2006, p. 16). This sits in direct contrast to the current structure of NCEA. Divided into 62 separate subjects, each comprised of up to 22 standards ("NCEA Standards Bank," n.d.), NCEA does not easily embrace integration (Granshaw & Hall, 2017). Unfortunately, once such a delicate ideal is released into the grinding, multi-toothed machine of a secondary school, it is inevitably mashed beyond recognition. Here lies the philosophical dilemma for teachers: how do we maintain the integrity of our guiding document, while providing our students with the best qualification they are capable of achieving?

Thankfully, the government has taken steps to address this very issue. Starting in 2018, NCEA underwent an unprecedented full-scale review—the Review of Achievement Standards (RAS)—seeking public voice on how best to improve our secondary school assessment system. Participants could share their opinions in a variety of ways: online via a quick survey or longer survey about the

Big Opportunities. ("The six Big Opportunities were suggested by a Ministerial Advisory Group as ways to strengthen NCEA." (New Zealand Council for Educational Research, 2018, p. 1)), or by making a submission. Over 8000 participants were also involved in workshops, focus groups, fono and hui. The "public engagement phase" (New Zealand Council for Educational Research, 2018, p. 1) generated four key findings:

- "Finding 1: Assessment, not learning, tends to be the focus of the senior secondary school." (p.11)
- "Finding 2: The focus on accumulating credits gets in the way of learning." (p.12)
- "Finding 3: NCEA creates workload issues for students and teachers." (p.13)
- "Finding 4: NCEA does not prepare all school leavers for their future." (p.14)

Following the review process, the New Zealand Government released the NCEA Change Package in 2019, to address the key issues identified by the public. This consists of seven major changes to the structure and administration of NCEA:

1. Make NCEA more accessible (by removing fees and making Special Assessment Conditions for students with learning needs easier to access);
2. Mana Ōrite mo te Mātauranga Māori (by making NCEA more inclusive to the needs and values of Māori ākonga/learners);
3. Strengthen literacy and numeracy requirements (by setting a single common benchmark level of literacy for all students to be achieved anytime from Level 1 onwards);
4. Have fewer, larger standards (by reducing the number of standards available to enter in each subject, but allowing for a broader range of content to be covered);
5. Simplify NCEA's structure;
6. Show clearer pathways to further education and employment (by simplifying the Record of Achievement and introducing Graduate Profile and Vocational Entrance Award)
7. Keep NCEA Level 1 as an optional level (for some learners this will be their highest qualification, so to remove it entirely would disadvantage them).

(Ministry of Education, 2019)

Once this overhaul of the system had been publicised, the re-write of the assessment material could begin. Subject Expert Groups (SEGs)—comprising teachers and educators from a range of settings—for the Trial subject of Level 1 Science, and Pilot subjects of English, Visual Arts, and Religious Studies, were established (Ministerial Advisory Group, 2019). Their mission was to decide what consititutes the most important learning for their subject area, then package this up into assessment tasks and supporting material that allow enough freedom for teachers to assess the key learning of their students, while honouring the principles of the NZC.

Late in 2019, the document containing the Phase 1 Products for the Trial subject Level 1 Science was released. This includes the draft Learning Matrix (key content to be covered in the course) and Assessment Matrix ("identifies the learning that is most important to credential and gives the titles of the four standards that will be used to do this, along with their mode of assessment and credit value"(Ministerial Advisory Group, 2019, p. 5)). This propses a dramatic change from the NCEA that science teachers are used to. The Science learning area at NCEA Level 1 now recognises the Big Ideas ***of*** Science (the essential knowledge learners need to gain from the course) and places greater emphasis on addressing the key competencies of the NZC through the Big Ideas ***about*** Science:

- Investigating in Science
- Using science to engage with real world issues
- Science as a human endeavour
- Communicating in Science

The rationale for selecting these four Big Ideas is clear: "They are aspects of mātauranga Pūtaiao and Science that will provide young New Zealanders with the skills, attitudes and capabilities to engage fully with life."(Ministerial Advisory Group, 2019, p. 3). The inclusion of a Māori world view in the Learning and Assessment Matrices and acknowledgement of Western Science as a branch of science that can be appreciated along with other views of scientific knowledge, (as opposed to the only way to approach science understanding) is revolutionary. It is an essential acknowldegement that the education system in New Zealand has been unfairly weighted against Māori learners, and is a step towards rectifying the issue of equity in education. It means that the way Science is taught and ultimately assessed in secondary schools will have to change:

> …in the Learning Matrix, some focus questions have been provided that span the strands of Significant Learning we associate with 'subjects' in order to provide opportunities to work with the interconnectedness of the Māori world view. This is a rich opportunity to move away from the compartmentalising of teaching and learning. (Ministerial Advisory Group, 2019, p. 12).

What this translates to is: Science will not be broken into its constituent parts for the sake of assessment. There are no subject boxes in life, and this will be reflected in the new Acheivement Standards for Level 1 Science. Learners will be given the opportunity to explore how science applies to them in real ways, without the constraints of being assigned as "Chemistry", "Physics", or "Biology" knowledge.

In line with the NCEA Change Package, there will be fewer, larger standards (Ministry of Education, 2019). The proposed Level 1 Science Achievement Standards will comprise four assessments, each addressing one of the four Big Ideas ***about*** Science:

	Achievement Standard 1.1	Achievement Standard 1.2	Achievement Standard 1.3	Achievement Standard 1.4
Standard Title	Use a range of scientific investigative approaches	Explore a real-world issue and devise a local, science-informed action	Describe attributes of Science that contribute to the development of scientific ideas and processes	Interpret scientific claims in publicly communicated information
Mode of assessment	**Internal**	**Internal**	**External**	**External**
Credits	**6**	**4**	**4**	**6**

Figure 2. Proposed NCEA Level 1 Science Achievement Standards (Ministerial Advisory Group, 2019)

Justification

The emphasis for assessment of these standards is that *there is no one-size-fits-all way to communicate understanding of science.* Students will be free to present their work in ways that best reflect their abilities, provided their teachers are willing to go along with it. Creative presentation of science information is proposed to become the norm: "Students are also communicators of science. Different audiences will require them to communicate their own findings and understandings in different styles."(Ministerial Advisory Group, 2019, p. 10). "…students will not be restricted to extended written text to provide evidence. They might use annotated diagrams, timelines, cartoons, etc. to contribute evidence."(Ministerial Advisory Group, 2019, p. 35)

This is a big philospophical shift for many teachers to get their heads around. Subject specialisation and traditional exams have been shunned in place of integration of knowledge and communication skills from a range of subject areas. Science teachers may now be expected to become experts in skills usually left to the arts subjects—such as visual design and storytelling—and may have to draw on knowledge from other learning areas to support science learning contexts. At the very least, they will need to accept that their learners will be encouraged to use creative methods to complete assessments and they may be required to help with this. This could be a step too far for some teachers, particularly if they began teaching in the era of norm-based assessment and have had their philosophical beliefs of teaching challenged once already with the introduction of NCEA in 2002.

Whatever the final outcome of this review and the proposed changes to NCEA assessment, teachers in New Zealand are going to need to embrace integrated learning as it forms a fundamental part of the NZC. They are going to need help. It is not an impossible task, as many teachers have already shown through their innovative practices. Their experience and expertise are vital to the development of an inclusive education and assessment system for our senior secondary school students.

1.2 Critical Review

Approaches to curriculum integration

Much time and effort has been devoted to proving that curriculum integration has a positive effect on learning experiences and outcomes for school students. This is a widely debated philosophy with a multitude of interpretations and appearances (Dowden, 2007). If we opt for a broad definition, Gehrke's (1998) is adequate:

> …it is a collective term for those forms of curriculum in which student learning activities are built, less with concern for delineating disciplinary boundaries around kinds of learning, and more with the notion of helping students recognize or create their own learning. (p. 248)

The key to this definition is the emphasis on the role of the student in their learning journey. This supports a constructivist view of learning, in which students form their own understanding of concepts based on their previous experiences and observations (Naylor & Keogh, 1999).

Let us now explore some of the other appearances combined learning areas can take:

- *Cross-curricular*: "When the skills, knowledge, and attitudes of a number of different disciplines are applied to a single experience, problem, question or idea" (Barnes, 2015, p. 11).
- *Transdisciplinary*: in which "subject boundaries are collapsed or merged" (Arrowsmith & Wood, 2015, p. 60);
- *Interdisciplinary*: in which subjects are still discrete but cross-over occurs when a specific skill (e.g. communication) is the focus of development.
- *Multidisciplinary*: one topic is covered across several subjects, maintaining their subject identity. (Arrowsmith & Wood, 2015).

The terms *integration* and *cross-curricular* learning are often used interchangeably by teachers. If one delves into the literature on the subject, one will find there are subtle differences between the

two. However, teachers have little time to do this for themselves and it has been reported that schools adopting these approaches prioritise the practice over the theory in professional development programmes (Arrowsmith & Wood, 2015). Perhaps then*, curriculum integration* is technically the wrong choice of terminology for bringing together subject content in the context of NCEA assessment. If we look at Beane's (1996) argument for curriculum integration, we can find that the *multidisciplinary* approach is a more accurate label. In this system, the teacher is still in charge of delivery of content knowledge and skills, and subjects maintain their discrete sets of content and learning spaces, but the crossover between them is identified and exploited (Beane, 1996). Beane is unashamedly scathing of this approach, and it is understandable: multidisciplinary learning is not as student-centred, nor does it mirror real-world contexts as effectively as integration does (Beane, 1996). Dowden (2012) echoes Beane's sentiments, but having experience with the New Zealand education system, he is able to appreciate that sometimes single subjects are preferable, especially in secondary schools. Because of this confusion of terms and the vast array of forms integration can take, I will assume that teachers reporting on use of integration in schools may be referring to any of the above practices (Drake, 2007). (In my 11 years of teaching experience, I have not heard teachers use the terms *transdisciplinary*, *interdisciplinary,* or *multidisciplinary* when discussing the implementation of integrated curriculum strategies. They are far more concerned about how they will manage to fit learning something new into their teaching schedule than what it is called). Consequently, from here on I will discuss curriculum integration as an overarching term for all practices that involve combining curriculum areas for learning in schools.

The Case for Curriculum Integration

Curriculum integration is a strategy with many potential benefits for both teachers and learners in New Zealand secondary schools. Combining school subject areas for project-based learning prepares students for life beyond school by giving them the opportunity to develop 21st century skills and apply these to real world situations (Arrowsmith & Wood, 2015; Taylor, 2018). This supports the recommendation of the NZC that, "Links between learning areas should be explored."(Ministry of Education, 2006, p. 39). The realignment of NCEA that took place in response to the release of the NZC supports this ideal as well (Edwards, 2013). When arts (such as drama, music, visual art) are integrated with other subject areas, students display a deeper understanding of content covered in class (DeMoss & Morris, 2002). Integration also caters for the cultural heritage of students in New Zealand classrooms. As asserted by Broughton and McBreen, (2015) often only the Western way of viewing subjects as separate disciplines is considered in course delivery, which does not fit with Māori world view. Breaking down the subject-imposed restrictions on students' learning may allow for greater connection with course content and consequently, better learning outcomes for them (Hadzigeorgiou, 2016). This also supports the commitment to the Treaty of Waitangi as outlined in

the NZC that New Zealand learners are situated in a bicultural environment (Ministry of Education, 2006).

There is evidence to suggest that secondary schools in New Zealand support an integrated approach to teaching and learning. In the report, *Secondary schools in 2018,* Bonne & MacDonald (2019) present findings from the 2018 national survey of secondary school teachers showing that 91 percent of teachers surveyed believe that making links between subject areas is important or very important. However, when asked if they had been part of an integrated teaching and learning environment only 30 percent responded affirmatively. Several reasons were given for this, to be discussed in the next section. Of the group of schools that had implemented integration on some level, it was deemed successful by 76 percent of their principals. Only 8 percent stated that it was not very successful and a mere 1 percent that it was not at all successful (the remaining 12 percent claimed it was too early to tell). This is a promising statistic and raises the question: do the rewards of curriculum integration outweigh the costs?

The Case Against Curriculum Integration

Integrated learning is wonderful ideal and is wholeheartedly supported by the NZC, but its implementation poses significant challenges for schools and teachers to overcome. Perhaps the most pressing for teachers as reported by school principals is the possibility that this approach may increase their workload (Bonne & MacDonald, 2019). Along with this is the risk that it may not improve learning outcomes for students and therefore would not be deemed worthwhile (Bonne & MacDonald, 2019). Although it is unpleasant to admit it, assessment is a significant driver in the design and delivery of courses in New Zealand secondary schools (Bonne & MacDonald, 2019; Edwards, 2013; Hipkins, 2014) and integration of subject areas does not take into account the complications imposed by NCEA (Granshaw & Hall, 2017). The pressure of ensuring students achieve as many credits as possible and to the best of their ability is a deterrent for rearranging the usual progression of content and incorporating innovative assessment tasks (Arrowsmith & Wood, 2015; Edwards, 2013; Rata & Taylor, 2015). Add to this Granshaw and Hall's (2017) view that the very nature of NCEA makes it near impossible for teachers to break down the boundaries between subject areas when the time comes to assess students' learning. Even if teachers want to provide innovative programmes of learning for their students, there is little room for this with limited cross-over for assessments between subject areas.

Dowden (2012) points out that secondary school teachers frequently define themselves by the subject they teach, rather than the learners they influence. This culture is heavily ingrained in schools, which makes it difficult to implement change in curriculum delivery, particularly when

specialist subject positions are threatened (Dowden, 2012; Osbourne, 2014). As well as this, specialist subject knowledge holds a place of esteem for many teachers and this can lead to fear that students will not have an adequate base for future learning (Arrowsmith & Wood, 2015). Some teachers lack the confidence to deliver a course that falls outside their area of expertise which can lead to added stress and a sense of loss (Edwards, 2013; Osbourne, 2014; Rata & Taylor, 2015). Secondary schools are places built on routine and the comfort of the expected. To meddle with the identity of subjects and disrupt the familiar timetable may be too much for many teachers to cope with (Arrowsmith & Wood, 2015). A great deal of effort and energy is put into providing time and space for each class to proceed and integration of courses and merging of spaces may be easier said than done for many schools (Arrowsmith & Wood, 2015).

The following statistics may lessen the severity of some of the issues identified above. According to Bonne and MacDonald's (2019) report, less than half of the teachers who had worked with integrated curricula reported an increase in workload, only 38 percent said that integration was more work with NCEA, and 33 percent even disagreed or strongly disagreed that integrated units were more work to assess. In contrast, a tiny 15 percent of teachers reported that integration did not work with NCEA. Also, 65 percent of teachers involved in integrated teaching and learning agreed that it improved their own engagement with course content and only 25 percent found that they could not cover course content in enough depth. Perhaps integration is not so bad after all.

Examples of curriculum integration

Let us now examine some benefits of crossing over subject knowledge and skills for our students. In their study, Arrowsmith and Wood (2015) interviewed teachers from four New Zealand secondary schools that had employed curriculum integration in some capacity. (As it transpired, three of them were practising multidisciplinary learning labelled as curriculum integration). The focus in these schools was giving students the opportunity to explore the interactions between areas of knowledge to put into use solving real world problems (Arrowsmith & Wood, 2015). The teachers in these schools all identified several benefits to both them and their learners. Decompartmentalisation of subject areas was of particular importance to teachers as they felt it better reflected the real world encountered by their learners. Another unexpected bonus was the development of stronger relationships between teachers and students that the student-centred approach allowed. Many teachers noted this was for them the best aspect of the programme (Arrowsmith & Wood, 2015).

Boyd and Hipkins (2015) echoed this finding in their report on schools participating in the *Sport in Education* project. This report outlines the experiences of six New Zealand secondary schools that designed cross-curricular courses around the theme of sport aimed to engage students at risk of

either underachieving or leaving school without a qualification. As well as positive relationship-building, schools noted a range of other benefits to their students, such as: increased confidence, higher attendance and retention rates, increased engagement and completion of class assignments, higher NCEA results, and decreases in behaviour issues (Boyd & Hipkins, 2015). The approaches the schools used were varied, but all were focused on designing courses centred around the interests and needs of their students and promoted positive interactions and teamwork within the group. This was often modelled by the teachers involved, as they too had to work together to deliver the course across a range of specialist subject areas (Boyd & Hipkins, 2015).

The insights provided by these studies are invaluable. For example, Boyd and Hipkins (2015) reported on the programme implemented in Aotea College in which students studied Mathematics combined with Physical Education (PE) with one teacher, and English and PE with another. These teachers combined NCEA standards across their respective subjects so that students could complete one project for credits in both curriculum areas. The class comprised 23 students, with 21 of them identifying as either Māori or Pasifika, and almost twice as many males as females. There was a difference in achievement for these students when compared to the matched control group of students who were not in this class: all achieved Level 1 Literacy and all but one achieved Level 1 Numeracy compared to 22 out of 23, and 17 out of 23 in the control group for these requirements respectively. In addition to this, 20 out of 23 students in the Sports Studies class achieved Level 1 NCEA with at least 80 credits, compared to only 15 out of 23 in the matched group. Course endorsements were also high, with almost half of the class earning over 14 credits at Merit or Excellence level (Boyd & Hipkins, 2015). The small sample size here makes it difficult to state with absolute certainty that these differences are significant, but there is a clear indication of promise in using these methods. The success of this programme can be attributed to the following:

- The teachers chose contexts for learning relevant to their students. Increased enjoyment improved engagement and completion of tasks.
- Students had continuity of learning with one teacher for two subjects.
- The Whānau environment of the class fostered an increased sense of belonging.
- The teachers made NCEA work for them, instead of working for NCEA.

Let me expand on that last point: part of the reason that these students exceeded expectations in this course was because they were not at the mercy of assessment. By combining standards across subjects in contexts that the students could relate to, the teachers managed to align their course with the NZC and still provide the qualification needed by the students. As noted by the researchers, “Students came into the Sport Studies class with the belief that being there would help with their

achievement." (Boyd & Hipkins, 2015, p. 7). With this increased confidence, students were more likely to put their best effort into assessment tasks (Black et al., 2002).

Papakura High School reported similar results for their cross-curricular Health and Sports Science Academy (HASSA) combining Health and PE, Mathematics, English and Science in Year 11. This programme was expanded after its first year to include Year 12 and 13 students studying Biology, PE, Health and History (Boyd & Hipkins, 2015). These classes stayed together for most subjects in a homeroom model to promote continuity of learning and positive relationship-building between students and teachers. The focus of this programme was to prepare students for careers in the Health and Sports Science sectors. As well as improvements in engagement and attendance, teachers noted higher NCEA pass rates, course endorsements and exam attendance for students in this programme. For example, in its second year, 75 percent of HASSA students gained Level 2 NCEA, compared with only 60 percent of students from outside the HASSA class. Again, standards were combined across subjects to increase the number of credits students could earn from a single project (Boyd & Hipkins, 2015). This difference between the HASSA and non-HASSA classes appears to be large. However, sample sizes were not reported so although positive, these results may not be entirely reliable.

These schools show that integration, cross-curricular study, or the multidisciplinary approach to teaching and learning are beneficial to students (whether you call it Arthur or Martha is arguably neither here nor there, what matters is that prioritising the needs of learners is the value at the core of it). Although these are only small studies of students in two schools, they do provide evidence to support this approach to teaching and learning. What is not reported in this summary of student achievement is the way in which students were assessed in each study. Single-project formats were alluded to, but this does not explain exactly what was required of the students for the assessments. Also, we must assume that the assessment practices employed by both schools are sound and results reported are reflective of the students' actual capabilities. When it comes to internally assessed standards especially, there is room for scepticism as some schools have not done the process any favours with less than honourable practices in the past. However, in this case it is safe to assume these results are accurate as all schools have systems in place to ensure validity of assessment tasks and marking practices and these are also moderated externally by NZQA (New Zealand Qualifications Authority, 2018).

Integration and NCEA Assessment

It is a disappointing fact that secondary school courses are largely driven by assessment (Hipkins, 2014). As Hipkins (2014) so aptly put it: "Any perceived high-stakes assessments send loud and clear

messages about what really matters for students' learning." (p. 46). Although it is supposed to be at the centre of school curriculum design, less than a fifth of teachers and principals say they are driven by the NZC in their course choices (Bonne & MacDonald, 2019). What does this mean for our learners? It means that for many of the courses they take, the purpose of lessons is not lifelong learning as the NZC states (Ministry of Education, 2006) but preparation for assessment with the ultimate goal of accumulation of credits (Rata & Taylor, 2015).

This raises several issues when it comes to students' motivation to learn. Firstly, if the focus is so heavily concentrated on assessment, the desire to achieve can override the will to learn (Black et al., 2002; Stiggins, 2002). Teaching and learning becomes a box-ticking exercise with teachers resorting to "teaching to the task" to give their students the best chance of success (Edwards, 2013). Students care less about what they are learning and more about the number of credits they can earn in completing a task (Rata & Taylor, 2015). Excessive assessment can have other negative effects on students' motivation. If learners enter an assessment task expecting to fail, unsure of what to do, or without a sense of connection to themselves or the world around them, they are less likely to try their best and to achieve well (Black et al., 2002; Hadzigeorgiou, 2016; Joyce & Hipkins, 2009; Stiggins, 2002). In the words of Stiggins (2002): "Some come to slay the dragon, while others expect to be devoured by it." (p. 761). According to Hipkins (2014), if we change our assessment practices, curriculum delivery will change in response. This is a case of the tail wagging the dog, but if it means that teaching and learning in our schools will be better suited to our learners, perhaps it is necessary. Effective assessment should encourage learning, not achievement (Black et al., 2002; Stiggins, 2002). It should cater to the abilities and cultural values of learners through thoughtful design and methods (Zemits, 2017). Assessment approaches should "suit the nature of the learning being assessed, the varied characteristics and experiences of the students, and the purpose for which the information is to be used." (Ministry of Education, 2006, p. 40).

Fortunately, the belief held by some teachers that the NZQA is an angry grown-up hovering above them with a stick ready to whack anybody who approaches assessment in an unconventional way is misguided. What I mean by this is that despite the fear that exists around it, NZQA fully supports innovation in assessment (Edwards, 2013) and this is reinforced by the philosophy of the NZQF that assessment can happen in a range of situations (NZQA, 2016).

Let us now narrow our focus to integration with science. According to the guidelines for Level 1 Science, "No restrictions exist on how communication occurs." (NZQA, n.d. cited in Edwards, 2013). Science teachers have been given free rein to assess their students' abilities:

> New Zealand science teachers do have considerable freedom in the design of assessment activities for the gathering of evidence of learning from their students. This means that they can incorporate their own students' interests and strengths into their teaching, and plan assessments that are responsive to their students' beliefs, values and experiences. (Edwards, 2013, p. 11)

Now that we agree that teachers of science can integrate other subject knowledge and skills into their assessment tasks, let us examine how this could be achieved.

Curriculum Integration with Science

One possible method of combining traditionally unconnected subjects such as science and the arts is to use narrative. Bruner (1991) defines narrative as, "an account of events occurring over time." (p. 6). Humans are wired to tell stories and to learn from them. As the difference between narrative and story is so subtle (a story places more emphasis on crafting the sequence of events around protagonists (Bruner, 1991)) the terms are frequently used interchangeably in literature. However, I will use the term "storytelling" from now as it better encompasses the connection between people and knowledge. Storytelling helps us to make sense of the world around us and share our understanding with others (Schank & Berman, 2002, cited in Avraamidou & Osborne, 2009). Murmann and Avraamidou (2014) summarise Bruner's (1991) model, "…narrative mode is the default mode of thinking. In our everyday lives this is how we organise our thoughts." (p.5). This is not a new idea, as much literature has been published about the benefits of incorporating stories into science teaching (e.g. Avraamidou & Osborne, 2009; Negrete, Lartigue, & Bruno, 2004; Vrasidas, Avraamidou, Theodoridou, Themistokleous, & Panaou, 2015). It has been shown that students are more likely to engage with scientific content when it is placed within a narrative framework and there is evidence that this also aids retention of information (Avraamidou & Osborne, 2009; Vrasidas et al., 2015). When given the opportunity to learn and communicate through stories, students who do not identify with the dominant culture of the classroom can find a way to connect with the subject matter and the teacher (Tolbert, 2015). This is reinforced by Bedford, (2001) who states that stories, "inspire an internal dialogue and thus ensure a real connection." (p. 29). Gilbert, Hipkins, and Cooper (2005) explain that through stories students are encouraged to use their imagination which allows them to see possibilities for themselves as having a place in the world of science. They also state that the use of storytelling in science can help learners to move beyond the mental block that scientific thinking imposes, as this does not come naturally to most people.

The use of storytelling in science education tends to be viewed from the perspective of communicating science knowledge to those who are not experts in the field, rather than encouraging

students to share their understanding through stories. For example, in their presentation at the *Redesigning Pedagogy: Research, Policy, Practice* Conference, Gilbert et al. (2005) shared their findings from a study into using stories to teach science in *kura kaupapa Māori* schools: "…schools in which children are taught entirely in *te reo Māori* (the language of the Māori—or indigenous—people of New Zealand), and according to Māori *kaupapa* (Māori principles or ways of doing things)." (Gilbert et al., 2005, p. 2). The authors critically evaluated several of the stories provided by the Ministry of Education for use in these schools to teach science alongside *Matauranga Māori* ["Māori knowledge" (Gilbert et al., 2005, p. 7)] and according to *Māori tikanga* ["Māori principles or the right ways of doing things in Māori contexts" (Gilbert et al., 2005, p. 7)]. What they reported was not terribly complimentary. Although the authors agree that use of storytelling in science education is an effective strategy and has the potential to engage a variety of learners in science, the stories they examined were not up to scratch. These stories were mostly traditional stories designed to teach both scientific content and *Matauranga Māori* but due to the disparate nature and origins of the two systems, they did not marry well.

This report highlighted issues for me to ponder. What if these studies are looking at the matter the wrong way around? So much emphasis is placed on *teaching* science through telling stories, but perhaps we should be focusing on our students *learning* science through their own stories. In my 11 years of teaching experience I have seen countless times just how desperate students are to tell their stories and to be heard. What if we could make learning in science a way for them to construct their own understanding by telling the story of their experience with it? Gilbert et al., (2005) make a valid point that science and stories are essentially different ways of thinking and eventually science students will have to separate the two if they are to demonstrate true understanding of science. However, they argue that we give up on storytelling too early in education and that it could still have its place in high schools. I agree.

Martin, Davis, and Sandretto, (2019) addressed this idea in their Science Video Project (SVP), in which they investigated the effect of using storytelling to communicate science understanding on engagement of adolescent students in science classes. Over four one-hour sessions, the students from four schools in New Zealand, aged 12-13 and 14-15, were given the skills to produce their own videos on aspects of science. The findings were encouraging: "The science mobile-filmmaking project was found to positively affect student engagement with science and develop skills across the curriculum." (Martin et al., 2019, p. 7). By creating their own stories around the science, injecting their personalities and humour—while also having fun—students were able to connect with the course content. They were also forced to revise the content many times through the process of researching, storyboarding, editing, and ensuring their films would appeal to the target audience of

their peers. The limits to the applicability of this study are only that the students involved were not yet far enough through their schooling to complete NCEA assessment tasks. However, these positive results provide strong evidence to pursue this method for assessment of NCEA Science standards.

Another science storytelling study was conducted by Aruffo (2015). In his project, he provided a workshop to university science students to build their skills in storytelling to improve their ability to present their research in formal settings. Every one of these students was anxious about giving a presentation and struggled to communicate their research in an engaging way. The workshop focused on the elements of a story—beginning, middle, and end—and linked these to the scientific research process. Data were gathered by surveys conducted both after the workshop and following their final presentation. All students reported that the workshop made it easier for them to write their presentation, talk about their experiment, and that they gained confidence in constructing a presentation in a conversational, narrative style. However, this did not remove their anxiety regarding delivery of the presentation to an expert audience.

It must be noted here that "all" means five. This was a very small study in a university setting, so to transfer these findings directly to students of NCEA would be unwise. However, this study does provide evidence that using narrative to organise, and present scientific data is effective for students' ability to communicate science to an audience.

In NCEA science courses, learners are often required to carry out scientific investigations and report on them. In my experience, it is notoriously difficult for students to connect the practical results with the written report. This study provides a new avenue for students to organise their findings and make some connection with the investigation they have carried out. Not only does personal connection improve learning outcomes as discussed earlier, but it ties in beautifully with the NZC's vision of "confident and creative, connected and actively involved" learners (Ministry of Education, 2006, p. 4).

Storytelling and Science Assessment

Here is what my research and experience in the New Zealand secondary school system has led me to propose: that storytelling techniques should be used by students of science in NCEA Levels 1, 2, and 3 to show their understanding of science concepts. These students should be able to gain credit for both their understanding of science knowledge and their presentation of this through integrated projects covering two or more NCEA standards, across subjects such as Science and English.

Stories can be told in a variety of ways—in writing, orally, visually through artwork, in film and via music—to name but a few (e.g.Martin et al., 2019; Negrete et al., 2004). Ideally all of these could be addressed in the creative project of this thesis, but in the interests of time (and perhaps sanity) my major focus will be on oral storytelling through podcasting. There are several reasons for this. Firstly, speaking stories aligns with the oral traditions of Māori culture (Gilbert et al., 2005). Thus, podcasting addresses the priority placed on Māori achievement by the New Zealand Government by encouraging the expression of understanding in culturally appropriate ways (New Zealand Government, n.d.). It also addresses my personal experience with students that many of them can explain scientific concepts verbally but struggle when asked to record these in conventional ways for assessment purposes. The work of Pegrum, Bartle, and Longnecker (2015) investigating the use of podcasting to improve university students' understanding of typically difficult chemistry subject matter provides encouraging evidence that this technique is beneficial for learning. After engaging in podcasting activities students showed increased understanding of these concepts in their final examination.

Personal Experience

I have also dipped my toes into the pool of science and arts integration through podcasting with great success. In 2018, the Year 13 Physics students in my school produced podcasts on the physics of music for an NCEA assessment task. I have never seen students so engaged in a project for an assessment and I believe this was due to the amount of freedom they were given in completion of the assignment. Students were able to express themselves however they liked on the podcast and they could choose any aspect of music as long as it tied in with Level 3 Physics. As well as the satisfaction of seeing students motivated to learn and enjoying the process, the results for this project were outstanding. 54 percent of students gained an "Excellence" grade for the assessment and only 3 out of the 57 participants didn't reach the standard for "Achieved" (there were mitigating factors in every case). The only downfall in this project was that I could only give students credits for the physics knowledge they demonstrated in their podcasts. They put so much time and effort into producing quality work that it seemed unfair not to reward them for it. This is why I am determined to take this project a step further in future. There may be a way to develop the skill of storytelling in science and to give students credit for being able to relate their knowledge in a creative, engaging, and personal way.

Requirements to Implement Change in Schools

Adopting a new approach to teaching and learning can be a scary proposition for teachers (Osbourne, 2014). As teaching is so closely connected with personal values, to challenge a teacher's style and

beliefs can be unsettling to the point of posing a threat (Arrowsmith & Wood, 2015; Osbourne, 2014). If teachers feel their position in the school system is threatened, they are unlikely to engage with the programme of professional development fully and they and their students will be worse off for it (Osbourne, 2014). It is therefore necessary to proceed with such changes with caution and sensitivity (Osbourne, 2014).

The literature on the matter highlights two major ingredients for successful change in curriculum delivery: support from leadership and professional development. Support from leadership is necessary both to get staff on board with the concept and for the practicalities of implementation such as arranging the timetable and classroom spaces (Arrowsmith & Wood, 2015; Bonne & MacDonald, 2019; Osbourne, 2014). Professional development is crucial for the success of curriculum change, and is in demand from teachers undergoing this process (Arrowsmith & Wood, 2015). The most beneficial model for this is ongoing support that teachers can opt into and is "planned around individual needs."(Arrowsmith & Wood, 2015, p. 63). Hipkins (2014) adds to this that "change will seem more compelling when teachers have access to clear examples of how the intended learning action might look" (p. 47). So, if teachers can be provided with the right support that is sensitive to their beliefs and values, curriculum integration can be implemented in secondary schools for assessment purposes.

Future Actions

From this literature review it is clear that there is a case for curriculum integration in New Zealand secondary schools for the purpose of NCEA assessment. So far, there is little to show that storytelling and science have been combined in this way for the improvement of learning and assessment outcomes for senior NCEA students. I intend to find out the level of interest among New Zealand Science teachers for incorporating this into their programmes and their professional development needs for this. My research will be centred around three key questions:

1. *What do teachers think about cross-curricular assessment of science and arts in NCEA?*
2. *What are the barriers to assessing more than one standard with a single project?*
3. *What do teachers need to overcome barriers to be able to use cross-curricular assessment for science and arts in NCEA?*

For the creative component of this thesis I will address the need for professional development highlighted by teachers. I will hold workshops with colleagues to help them upskill in the area of podcasting with their classes. I will also create a website that will provide resources for teachers who are interested in this approach to assessment. This will include classroom resources for practical activities to develop skills in presenting science as stories as well as avenues for follow-up support

and connection between teachers interested in storytelling for science assessment. Unfortunately, due to the RAS currently in progress, the standards as we know them now will not exist after 2020. Therefore, tailoring my resources to specific standards could prove to be a futile exercise. However, the NZC will maintain its structure and vision and I argue that as the tension between the NZC and the NCEA should be alleviated by this restructuring of NCEA, my approach to teaching and learning will be even more relevant following this than it is now. The goal of this research is to answer the question:

What types of professional development can help teachers overcome barriers to combining NCEA science and arts achievement standards in a single project?

Chapter 2: Online Questionnaire

2.1 Introduction

Several studies have been conducted in New Zealand to examine the effects of innovative, cross-curricular practices in NCEA courses (e.g. Arrowsmith & Wood, 2015; Hipkins & Spiller, 2012). Findings from these indicate that both teachers and learners can benefit greatly from the process of completing a course that draws on knowledge and skills from a variety of subjects. For students, the benefits were: improved engagement, higher achievement, and increases in enjoyment, confidence, appreciation for teacher effort, understanding of content and its relevance, attendance, and retention in school courses. Plus, there was a decrease in behavioural issues. For teachers the benefits were: an opportunity for personal professional development, more time to devote to preparation for externally assessed standards in class, and enhanced relationships with other teachers and students (Arrowsmith & Wood, 2015; Boyd & Hipkins, 2015; Hipkins & Spiller, 2012). Teachers who had implemented cross-curricular courses, such as the Sport in Education programme offered to students at risk of not achieving in NCEA, were positive about the process. For instance, teachers from Aotea College, Papakura High School and Tauranga Boys' College all reported their intention to repeat the course a second time, despite difficulties they encountered with fitting it into the school year plan (Boyd & Hipkins, 2015). This is evidence that experience of creative cross-curricular assessment could lead to more positive teacher attitudes towards its implementation.

Teachers with at least 20 years' experience in the New Zealand education system would have taught under both NCEA and its predecessor: the combination of School Certificate, Sixth Form Certificate and Bursary at Years 11, 12 and 13, respectively. The difference between these two systems is vast and requires a considerable shift in teaching philosophy. In their study of early adopter schools of curriculum integration under the "new" curriculum, Arrowsmith and Wood (2015) noted the difference in attitudes held by teachers and the effect this had on curriculum implementation. Where teachers did not feel the structure of the course aligned with their own philosophy of teaching and learning, the integrated programme was not effectively implemented and quickly petered out. It is possible that teachers who have had longer to become entrenched in their personal philosophies about teaching and learning—especially those who began teaching under a more traditional single subject system—may be less inclined to employ innovative assessment practices. Potentially, less established teachers will be more open to changing their thinking and practices about assessment and will be more positive about creative cross-curricular assessment. As noted by Timperley, Wilson, Barrar, and Fung, (2007) "Reconstruction of professional knowledge is

more difficult than its original construction" (p. 13). As a teacher progresses from novice to expert, they develop patterns and processes based on their beliefs and experiences in the classroom (Timperley et al., 2007). Therefore, it may be that teachers who have had less time to fully construct a framework of beliefs and values around teaching and learning are more likely to embrace innovative practices.

With these ideas in mind, two hypotheses were formed for the online questionnaire:

1. That previous experience of combining standards from different subjects for assessment will have a positive effect on teacher attitudes towards creative cross-curricular assessment.
2. That years' teaching will have a negative effect on teacher attitudes towards creative cross-curricular assessment. That is, that teachers with more experience teaching will be less likely to implement creative cross-curricular assessment methods.

The question this research seeks to answer is:

What types of professional development can help teachers overcome barriers to combining NCEA science and arts achievement standards in a single project?

2.2 Methodology

To address this question a mixed-methods approach was employed consisting of a survey in the form of an online questionnaire, and semi-structured interviews with individual teachers (to be discussed in the next chapter). This was modelled on the mixed-methods approach used in many educational studies requiring teacher input, including the recent NCEA review (New Zealand Council for Educational Research, 2018). Check andSchutt, (2012)discuss the advantages of employing mixed-methods in educational research. For example: use of both qualitative and quantitative data can provide a range of information that cannot be extracted by one method alone (for example comparison of reported enjoyment of a course and student learning outcomes via test scores); discrepancies between qualitative and quantitative data sets can be examined and further research proposed; participants can be given an opportunity to express their views effectively in more than one way.

Each of the methods employed was centred around the three key questions:

1. What do teachers think about cross-curricular assessment of science and arts in NCEA?
2. What are the barriers to assessing more than one standard with a single project?
3. What do teachers need to overcome barriers to be able to use cross-curricular assessment for science and arts in NCEA?

The rationale for mixing methods is to give a clearer picture of the opinions of New Zealand secondary school science teachers about cross-curricular assessment. The questionnaire provides quantitative data with some relatability by involving over 100 participants; the interviews provide qualitative data in the form of individual teacher's experiences and thoughts—with the opportunity to cover issues, ideas and solutions not previously considered—in greater depth than the questionnaire.

The bulk of the quantitative data for this research came from an online questionnaire for science teachers in New Zealand, using the Qualtrics survey tool. This tool allows researchers to generate a questionnaire using a variety of question structures such as Likert scales, drop-down menus, and open-ended questions. Once the survey has been completed, the software provided allows for in-depth analysis of data collected. The survey method was chosen as it is an, "Efficient method for systematically collecting data from a broad spectrum of individuals and educational settings."(Check & Schutt, 2012, p. 160). It was divided into three sections addressing the three key questions, with the purpose of gaining an overall impression of teachers' views on cross-curricular assessment and professional development opportunities. The planning process for this followed the methods outlined in literature on educational research practices (Bernhardt & Geise, 2009; Check & Schutt, 2012). The instrument was designed to be completed in approximately five to 10 minutes and consisted of Likert-type questions, drop-down menus, and choice of preference from a list of options. The option of "Don't Know" was included in many of the questions to counter the effect of participants "who choose a substantive answer when they really do not know."(Check & Schutt, 2012, p. 169). There were some opportunities for extra comment, but these were not compulsory. Demographic information was collected for statistical analysis and as recommended by Check and Schutt, (2012) categories for this were modelled on other educational surveys carried out by the New Zealand Council for Educational research (Bonne & MacDonald, 2019; New Zealand Council for Educational Research, 2018). (See Appendix A for final survey instrument). Of particular interest were the effects of participants' previous experience using cross-curricular assessment, and the number of years they had been teaching on their attitudes towards cross-curricular assessment and their professional development needs.

As pointed out by Check & Schutt, (2012) the format of a survey instrument has an impact on response-rate. For this reason, much thought was put into wording and order of questions to ensure the survey progressed logically, and to promote ease of use. The teaching profession places huge demands on teachers' time, and it was crucial to make this process as painless as possible for my fellow teachers. Also considered was my personal experience, that if a survey is going to take more than 10 minutes to complete or involves answering questions that require more than an absolute minimum of thought, responding will be an unattractive option. In the words of Simpson, (1984) "If

you want to gather information from people, you must make it as easy as possible for them to understand, answer, complete and return the forms." (p. 122). The instrument was piloted with a group of individuals including current teachers, staff members of the Ministry of Education and the Teaching Council, among others both with experience of the New Zealand education system and without. This was to ensure ease of use, clarity, and that technicalities of completing the survey were in order (Bell & Waters, 2014; Simpson, 1984). Feedback was generally positive, and only a few adjustments to the final questionnaire were needed.

Ethical considerations for the research process were of course made, as per the University of Otago ethics guidelines. Information was provided to all participants detailing the future use of the data collected and the option to give consent was embedded in the survey. Anyone who did not give consent to be involved in this study did not see the rest of the questionnaire. Participants could also opt out at any time. According to Check and Schutt, (2012), the main ethical concern for survey research is participant confidentiality. For this reason, all information was kept confidential and participants maintained their anonymity throughout the process. Demographic data was collected to allow for in-depth analysis of responses. (See Appendix B for ethics approval documentation).

Questionnaire Distribution

To determine the number of teachers to survey, the ideals outlined by Cohen, Manion, and Morrison, (2011) were referred to. They are realistic in their advice about educational research, especially when conducted by an independent researcher for personal study: "… time, money, stress, administrative support, the number of researchers and resources" (p. 145) are identified as factors that may affect sample size and allowance is made for this. They cite Borg and Gall (1979, pp. 194-5) in stating that "Survey research should have no fewer than 100 cases in each major subgroup"(Cohen et al., 2011, p. 145). Initially, calculation of target sample size was carried out, using the formula recommended by (Cohen et al., 2011). However, following consultation with statistics expert Dr Tom Swan (Department of Psychology and Centre for Science Communication, University of Otago), it was decided a bare-minimum number of 100 responses would be necessary for analysis, taking into account the restricted time and resourcing of this study. Bell and Waters (2014) justify such a decision with this advice: "You just do the best you can in the available time." (p. 120). In the end, all data are valuable for this research and informing the creative project, as suggested by (Check & Schutt, 2012): "The raw number of cases matters more than the proportion of the population." (p. 31).

Once target sample size had been determined, distribution of the survey was addressed. Heads of science subject associations—groups of teachers connected via their association leader for the

purpose of sharing subject-specific information and resources and providing professional support to each other—were emailed in advance to ask for their support. The contact details for the head of each association are published on the New Zealand Association of Science Educators (NZASE) website (New Zealand Association of Science Educators, n.d.). Those who replied were sent the survey link (these were: Physics, Biology, Chemistry, Agriculture, Canterbury Science, Otago Science, Wellington Science) and were asked to circulate this to the teachers on their databases. The rationale behind restricting this questionnaire to science teachers only was that some of the questions depend on subject-specific experience. Although there may have been teachers in other departments with interest in this project, it is beyond the scope of this thesis to include a wider range of subject areas. Bell and Waters (2014) suggest an appropriate length of time to give participants to respond to a questionnaire is two weeks and to include a due date in the invitation. However, this was not feasible with this study as distribution of the survey link was dependent on heads of subject associations. As it was carried out at the worst possible time of year for adding to teacher workload (the final week of Term 3) there was a delay of up to three weeks before the link was passed on to subject association members. For this reason, a reminder was sent to subject association heads after three weeks, followed by a reminder for participants including the survey link another week later.

The biggest limitation to this method of sampling was getting teachers to open the email containing the survey link. On the advice of a colleague—who as an active member of several subject associations receives a multitude of emails a day—catchy subject headings were chosen. Unfortunately, this method relied on the relationship the heads of subject associations had with their members. It is possible that the sheer volume of information distributed to association members via email from their leaders has a negative effect on likelihood of emails being opened. This highlights the importance of having a personal connection with participants in educational research (Bell & Waters, 2014).

Alternative distribution method

To address the need for connection with participants, social media was used as a second method of distribution of online questionnaires. As noted by Bell and Waters, (2014) use of social media in data collection has the potential to save enormous amounts of time, effort and money. After three weeks of email distribution, the survey was posted to the New Zealand Science Teachers (NZST) Facebook group consisting of 1 653 members. This is a private group and members are all current science teachers at New Zealand schools as verified by the administrator. Approximately one week after this, the link was made available to the New Zealand Physics Teachers (NZPT) Facebook group of 691 members, and almost two weeks later to CoMPaSS PLG, a group of 74 members focused on cross-curricular teaching and learning in science. These are also private groups, with members needing a

personal invite to join (which explains why the post to CoMPaSS PLG came so much later). A promotional animation was posted at the same time as the survey link to further clarify the aims of the research. Reminders were posted to the New Zealand Science and Physics Teachers' pages at the same time as the first post to CoMPaSS PLG, with one week of the survey remaining. The response rate increased dramatically following implementation of social media distribution after three weeks of email distribution, with an extra 36 responses being recorded via this link.

There are limitations to gaining a sample this way. It takes a certain kind of teacher to be active on social media and to voluntarily participate in discussions. By sending a questionnaire to this group, a significant proportion of the teaching population was missed. Many teachers stay away from social media to maintain a professional distance from students (although Bell and Waters (2014) quite rightly point out that most teenagers prefer other applications over Facebook as their parents use it) and many others are not involved in the New Zealand Science Teachers group, or do not have the time to spend on social media. This could have skewed results as teachers involved in the NZST and NZPT groups are clearly interested in keeping up to date with the latest ideas in science education (based on the nature of their posts) and CoMPaSS PLG is dedicated to the cross-curricular approach to teaching and learning. Therefore, teachers in these groups are more likely to respond to a survey and more likely to be positive about innovative assessment ideas. It must be noted here that due to the anonymous nature of questionnaire responses it is impossible to know for sure which of the Facebook groups respondents were members of. However, the survey software recorded that 75 questionnaires were accessed via anonymous link and only 36 via social media. It is fair to say then, that this potential bias is minimal.

Questionnaire Limitations

As with any research of this nature, there are limitations to the online survey method. The voluntary nature of participation in the questionnaire lends itself to misrepresentation of the population as certain types of people are more likely to respond than others. This could skew the data towards people who are more likely to have a positive view on educational issues, as they may feel more inclined to help. Cohen et al., (2011) provide justification for the use of non-probability sampling in this instance. As this is a very small-scale study, it is unrealistic to expect to gain access to the whole population of secondary science teachers in New Zealand. In fact, this thesis does not claim that results from the survey are generalisable to the population in question, rather just the sample of teachers who responded. In their words, non-probability samples, "are far less complicated to set up, are considerably less expensive and can prove perfectly adequate where researchers do not intend to generalise their findings beyond the sample in question." (Cohen et al., 2011, p. 155).

The issue of social desirability ("The tendency for individuals to respond in ways that make them appear in the best light" (Check & Schutt, 2012, p. 169)) was circumnavigated as best as possible by the design of the questions. To discourage participants from answering questions in a way that did not reflect their true views, but their perceived preferable views, open-ended questions were be kept to a minimum and made optional, and where possible, a 1-5 Likert scale of answers was used, starting with the most negative option and increasing values to the most positive. This is because respondents are more likely to choose an option on the left-hand side of a scale, and even more so if the response is a positive one. By placing the most negative option on the left, this bias can be lessened (Friedman and Amoo, 1999; Hartley and Betts, 2010, cited in Cohen et al., 2011).

Response rate is the most challenging issue to overcome in questionnaire research and to keep this as high as possible, reminder emails were sent and reminder messages posted to the NZST and NZPT Facebook pages (Bell & Waters, 2014). Hindsight is a wonderful thing, and the advice given by Check and Schutt, (2012) to provide an incentive to participants in the survey might have induced a larger response rate. However, I truly believed that there would be enough goodwill in the teaching community to support this research with only the promise of free resourcing at the end of it. Once again, Bell and Waters (2014) show their realistic appreciation for educational research: "Your aim is to obtain as representative a range of responses as possible to enable you to fulfil the objectives of your study and to provide answers to key questions" (p. 123).

2.3 Questionnaire Results

A total of 111 responses were obtained for the online questionnaire. Some of these were incomplete as participants could leave the questionnaire and return to it later and the software recorded the response as ended after one week of inactivity. The aim of this questionnaire was not to generalise results to the entire science teaching population of New Zealand, but to identify issues that could inform the resourcing for teachers interested in creative cross-curricular assessment of science, which informs the creative project of this thesis. With this in mind, 111 responses were sufficient. The following graphic summarises the demographics of the teachers who volunteered to participate in the questionnaire:

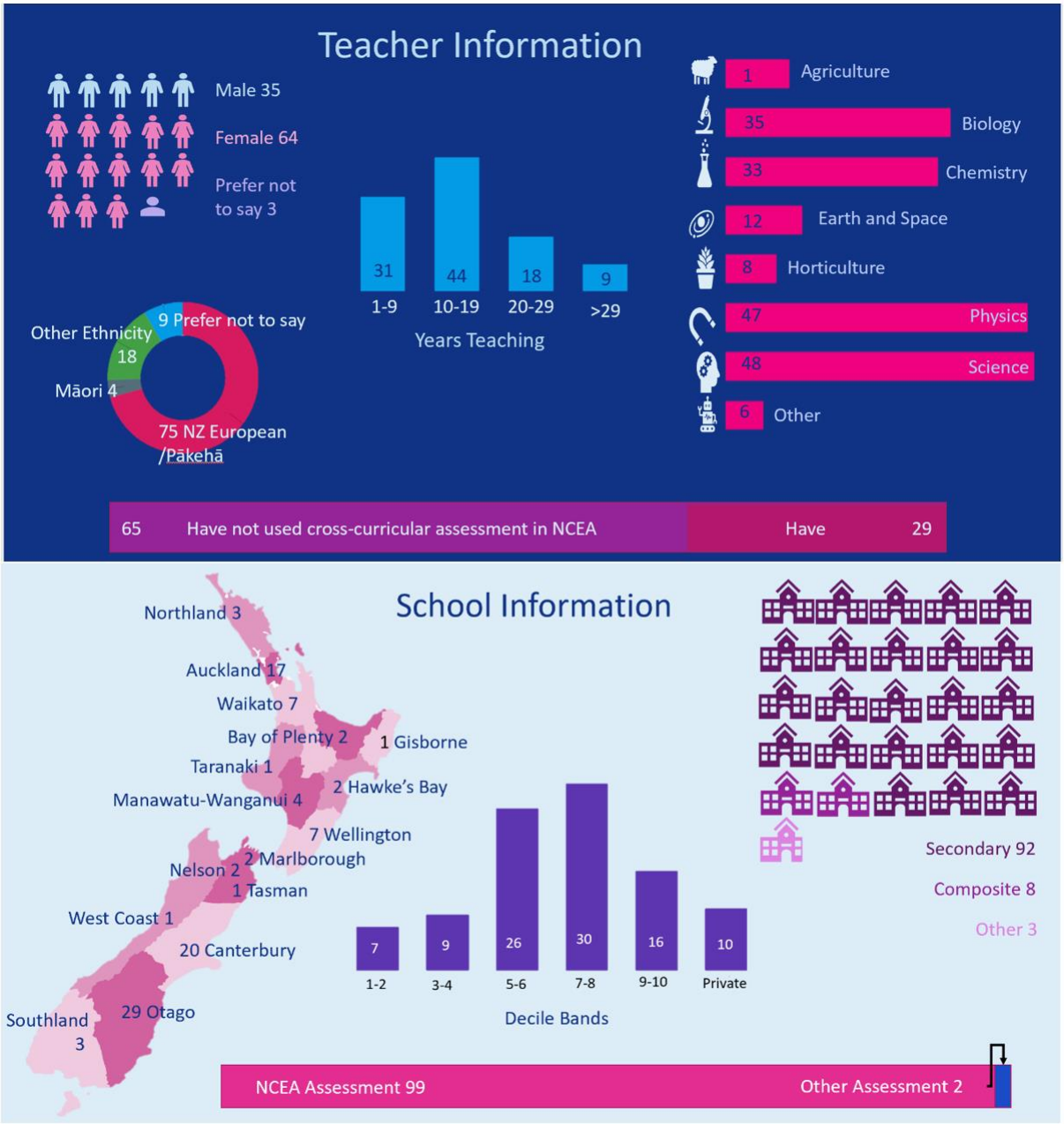

Figure 3. Summary of participating teachers in Storytelling for NCEA Science Assessment questionnaire. (NZ map image: Richardson (2017))

When demographic information is compared to the data available on New Zealand teachers and schools, (Education Counts, 2019) it is clear that the participants in this questionnaire did not represent the true proportions in the teaching community. (It should be noted here that Education Counts provides statistical information for all teachers in New Zealand and does not differentiate them by the subjects they teach. It is possible that the secondary science teaching population may have different demographics than what is reported on Education Counts). For example, there was over-representation of teachers from the South Island, particularly the Otago region. This was not unexpected as this was where I had the most personal contacts. The spread of school deciles in this study was roughly a normal distribution, however the actual population deciles were approximately evenly distributed through the range of deciles. The balance of male to female teachers was very

close to the population statistics (although, Education Counts does not have the option of "prefer not to say"). The ethnicity of participants in this questionnaire did not reflect the teaching community in New Zealand, with Pasifika and Asian teachers not represented at all (although, potentially, some respondents might have been included in the group that preferred not to say). The Physics teaching community was surely overrepresented in this questionnaire, which is most likely due to my personal connection with this group of teachers.

A notable statistic from this questionnaire is the number of teachers who had previous experience of using cross-curricular assessment in NCEA science courses. Of the 92 teachers who responded to this item, 65 had not used this method previously (71%). This aligns almost exactly with the data reported by Bonne and MacDonald, (2019) in their report on current practices in New Zealand schools. Comparison of their attitudes and opinions with teachers who have experience using cross-curricular assessment with their classes will prove instrumental in this study.

Results and Analysis

For all Likert-type questions, options were assigned numerical values on the following scale: 1 = strongly disagree; 2; 3 = neither agree nor disagree; 4; 5 = strongly agree. In questions that had "Don't Know" as an option, this was excluded from calculations. The measure of central tendency used for analysis was the mean value on this scale. This is because the scale is limited to only five values, so outliers will not affect the mean significantly. It is also a useful statistic to give a picture of general trends (Cohen et al., 2011). Median and mode were calculated, but due to the narrow range of the scale used for responses, they provided little insight into trends in results.

Research question one: What do teachers think about cross-curricular assessment of science and arts in NCEA?

This section was divided into two categories: teacher attitudes towards creative cross-curricular assessment and teacher attitudes towards student outcomes using creative cross-curricular assessment.

Teacher attitudes:

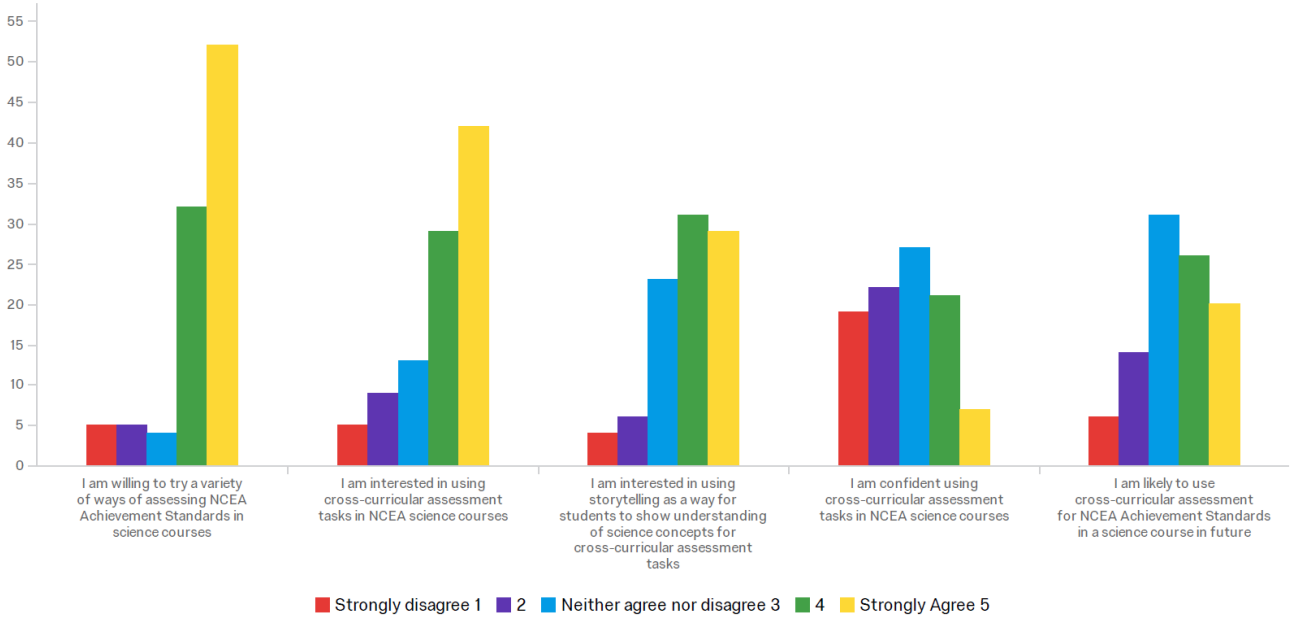

Figure 4. Teacher attitudes towards creative cross-curricular assessment

In general, the teachers surveyed were interested in using creative assessment methods for NCEA science courses but lacked confidence in doing so. Responses were grouped into positive ("agree" and "strongly agree") and negative ("strongly disagree" and "disagree") (Cohen et al., 2011). More teachers showed positive responses than negative when asked if they were interested in using a variety of methods of assessment (84 out of 98 responses) and cross-curricular assessment (71 out of 98). However, this was the reverse when teachers were asked if they were confident in doing this (28 out of 96 responses). Use of storytelling showed interest overall with a mean rating of 3.8, and with more positive than negative ratings (60 out pf 93 responses). However, it also returned a high proportion of neutral answers (23 out of 93, or 25 per cent).

Further analysis can show whether this is more pronounced in certain groups of teachers. To test whether the attitudes of teachers was affected by previous experience of cross-curricular assessment, I compared mean attitudes using Mann-Whitney U tests (Cohen et al., 2011). To test whether attitudes of teachers varied depending upon years teaching, I used Analysis of Variance (ANOVA) as per Kiraz and Yildrim (2007). The confidence level for this was 95%. A significant finding in this case—with a p-value of less than 0.05—means that for 95 per cent of the population, the relationship between the variables is not due to chance. A p-value of less than 0.01 and a p-value of less than 0.001 demonstrate the same for 99% of the population and 99.9% of the population, respectively (Cohen et al., 2011).

Table 1. Mann-Whitney U test of difference of means for teacher attitude towards cross-curricular assessment between teachers with previous experience of cross- curricular assessment (PE) and teachers with no previous experience (NPE)

Statement	Mean rating by previous experience ($\bar{x}$)		p-value
	PE	NPE	
I am willing to try a variety of ways of assessing NCEA Achievement Standards in science courses	4.6 (n=29)	4.1 (n=65)	0.077
I am interested in using cross-curricular assessment tasks in NCEA science courses	4.7 (29)	3.6 (65)	0.000***
I am interested in using storytelling as a way for students to show understanding of science concepts for cross-curricular assessment tasks	4.0 (27)	3.7 (62	0.271
I am confident using cross-curricular assessment tasks in NCEA science courses	3.7 (29)	2.3 (63)	0.000***
I am likely to use cross-curricular assessment for NCEA Achievement Standards in a science course in future	4.0 (29)	3.1 (64)	<0.001**

*** p-value of less than 0.01 *** p-value of less than 0.001*

Teachers with previous experience of cross-curricular assessment were more likely to be more interested, confident, and likely to use cross-curricular assessment tasks than teachers who had no previous experience. This supports hypothesis one, that previous experience using standards from different subjects for assessment has a positive effect on teacher attitudes towards cross-curricular assessment. Perhaps not surprisingly, teachers in the PE group were positive about their confidence using cross-curricular tasks, whereas teachers in the NPE group averaged a negative response to this. The overall mean for this was 2.7, indicating that this was an issue for all teachers surveyed. However, the PE mean of 3.7 is on the positive side of the scale, indicating that previous experience had a significant impact on confidence.

Table 2. ANOVA of difference of means for teacher attitude towards cross-curricular assessment between years teaching groups

Statement	Mean rating by years teaching ($\bar{x}$)				p-value
	1-9	10-19	20-29	>29	
I am willing to try a variety of ways of assessing NCEA Achievement Standards in science courses	4.3 (n=30)	4.3 (n=42)	4.1 (n=17)	3.7 (n=9)	0.024*
I am interested in using cross-curricular assessment tasks in NCEA science courses	4.1 (30)	4.0 (42)	4.1 (17)	3.0 (9)	0.000***
I am interested in using storytelling as a way for students to show understanding of science concepts for cross-curricular assessment tasks	4.0 (26)	3.8 (41)	3.8 (17)	3.2 (9)	0.024*
I am confident using cross-curricular assessment tasks in NCEA science courses	2.4 (29)	2.9 (41)	2.9 (17)	2.8 (9)	0.376
I am likely to use cross-curricular assessment for NCEA Achievement Standards in a science course in future	3.4 (30)	3.5 (41)	3.5 (17)	2.9 (9)	0.203

** p-value of less than 0.05; *** p-value of less than 0.001*

Increase in years teaching may have a negative effect on teachers' willingness to try a variety of tasks and their interest in cross-curricular and storytelling tasks. Teachers in the >29 years teaching group had the lowest average rating for every item except: *I am confident using cross-curricular assessment tasks in NCEA science courses*, in which all groups rated on the negative end of the scale.

Teacher attitudes towards student outcomes:

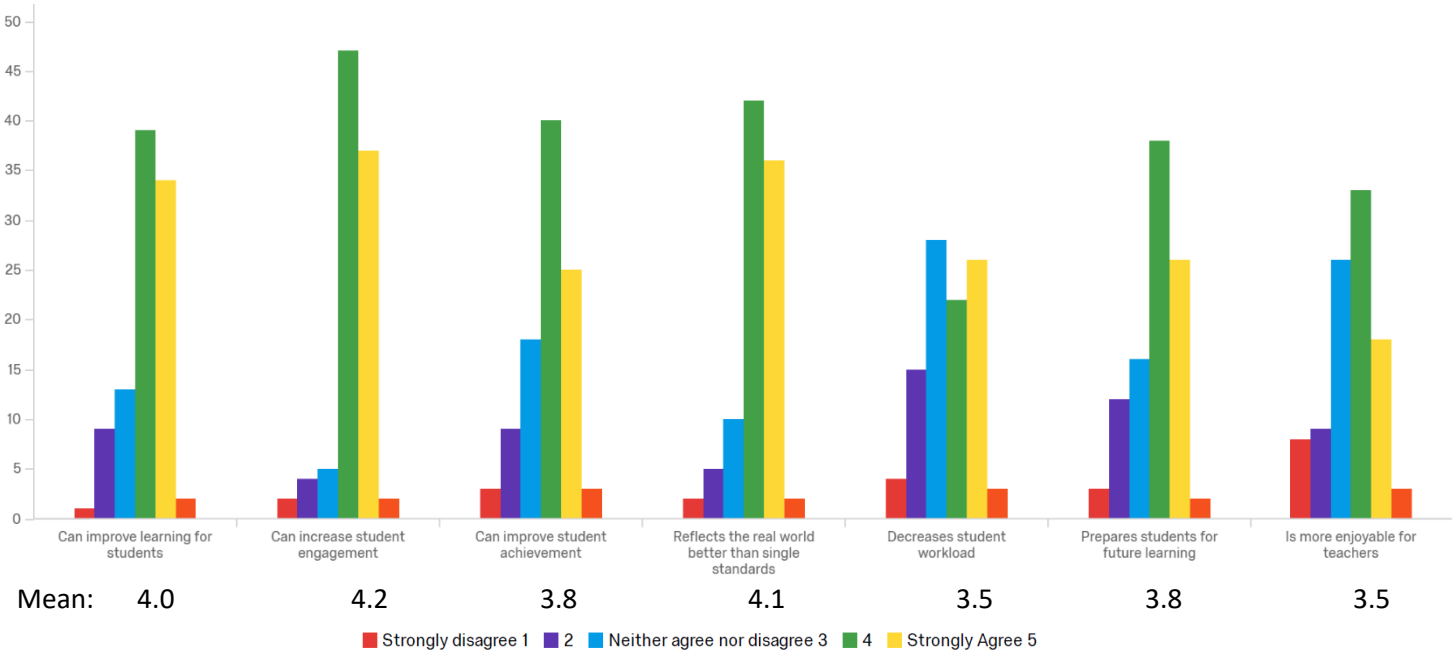

Figure 5. Teacher attitudes towards student outcomes using creative cross-curricular assessment.

In general, teachers surveyed believed that student outcomes will be positively affected when cross-curricular assessment tasks are used, especially in the areas of learning, engagement, and reflection of the real world. Decrease in student workload showed the least agreement amongst participants. Once again, results were analysed to determine if previous experience and years teaching influenced teacher attitudes.

Table 3. Mann-Whitney U test of difference of means for teacher attitude towards student outcomes using cross-curricular assessment between teachers with previous experience of cross- curricular assessment (PE) and teachers with no previous experience (NPE)

Statement	Mean rating by previous experience ($\bar{x}$)		p-value
	PE	NPE	
Can improve learning for students	4.3 (n=29)	3.8 (n=63)	0.024*
Can increase student engagement	4.3 (29)	4.1 (62)	0.280
Can improve student achievement	4.1 (29)	3.7 (62)	0.041*
Reflects the real world better than single standards	4.5 (28)	4.1 (63)	0.038*
Decreases student workload	4.0 (29)	3.3 (62)	0.011*
Prepares students for future learning	4.2 (29)	3.6 (62)	0.009**
Is more enjoyable for teachers	4.0 (62)	3.3 (28)	0.015*

** p-value of less than 0.05; ** p-value of less than 0.01*

Previous experience had a positive effect on teachers' attitudes towards student achievement using cross-curricular assessment tasks for all items except: *can increase student engagement*, where attitudes of both groups were positive.

Table 4. ANOVA of difference of means for teacher attitude towards student outcomes using cross-curricular assessment between years teaching groups

Statement	Mean rating by years teaching ($\bar{x}$)				p-value
	1-9	10-19	20-29	>29	
Can improve learning for students	4.1 (n=30)	4.0 (n=41)	4.0 (n=16)	3.4 (n=9)	0.020*
Can increase student engagement	4.4 (29)	4.3 (41)	4.1 (16)	3.4 (9)	0.001**
Can improve student achievement	3.9 (30)	3.9 (40)	3.9 (16)	2.8 (9)	0.002**
Reflects the real world better than single standards	4.3 (28)	4.1 (40)	4.1 (16)	3.6 (9)	0.007**
Decreases student workload	3.4 (29)	3.8 (41)	3.6 (16)	2.7 (9)	0.044*
Prepares students for future learning	3.7 (29)	3.9 (41)	4.0 (16)	3.2 (9)	0.136
Is more enjoyable for teachers	3.4 (28)	3.6 (41)	3.6 (17)	2.6 (8)	0.000***

** p-value of less than 0.05; ** p-value of less than 0.01; *** p-value of less than 0.001*

Increase in years teaching had a negative effect on teacher attitudes towards student outcomes for all items except: *Prepares students for future learning*. Most notably, teachers in the >29 years teaching group were significantly less convinced that cross-curricular assessment is more enjoyable for teachers, with a mean rating in the "disagree" category. This group also disagreed with the statements: *can improve student achievement* and *decreases student workload*. This supports hypothesis two, that increase in years teaching has a negative effect on teacher attitudes towards creative cross-curricular assessment.

Written responses:

Participants were given the opportunity to voice issues not raised by the Likert-type questions with the open-ended question: *Are there any other thoughts you have about using cross-curricular assessment not listed above? Please list them here (optional):*

This type of question is known to prompt responses from participants who feel particularly strongly about an issue (Bell & Waters, 2014). A total of 32 participants took this opportunity and most used it to express concerns with cross-curricular assessment. Responses were categorised based on overall sentiment of the comment (positive, negative, neutral, or a combination), then further sorted into the following codes: Workload Issues; NCEA restrictions; Teacher Issues; Student Needs; and Other. Many comments spanned more than one category. A codebook was written and cross-checked for definition of categories and accuracy of categorisation (See Appendix C for codebook).

Of the 32 comments, five mentioned previous experience or attempts at cross-curricular assessment; 19 were entirely negative about cross-curricular assessment; five were entirely positive; and three were entirely neutral comments based on teacher thoughts. Four comments raised both positive and negative points and two included both negative and neutral ideas. Most comments related to experienced or perceived issues with cross-curricular assessment.

Table 5. Summary of written responses to questionnaire section one.

Issue	Responses	Number of responses
Workload (n=8)	Experienced or perceived increase in workload: teachers (3); students (2) Experienced or perceived decrease in workload: teachers (1); students (2).	5 3
Teacher Issues (n=24)	This category was divided into several subcategories: **Time:** participants lamented the lack of available time to develop a programme including cross-curricular assessment. **Preference:** these teachers explained their preference for other forms of teaching and learning and/or dislike of cross-curricular assessment. **Co-operation:** these comments outlined issues with working with other teachers to make cross-curricular assessment successful. **Discomfort:** teachers expressed their own or others' perceived lack of comfort, knowledge, or willingness with using cross-curricular assessment. **Timetabling:** this comment mentioned issues with co-ordinating the school timetable. **Subject integrity**: these comments raised issues with subjects maintaining specialist language and knowledge. (Included here as it is highly contested amongst teachers). **Interest:** these teachers expressed interest in using cross-curricular assessment and/or storytelling for NCEA science.	 4 3 6 5 1 2 3

NCEA Restrictions (n=13)	This category was divided into three subcategories: **Standard alignment:** several teachers noted the difficulties imposed by prescriptive standards for NCEA assessment, that different subjects have very different requirements and weightings. **Changes:** NCEA was under review at the time this questionnaire was circulated. These teachers mentioned the issues they or other teachers may foresee with this. **Marking:** this comment outlined experienced issues with marking standards from outside a teacher's specialist subject are.	8 4 1
Student Needs (n=12)	This category was divided into four subcategories: **Difficulty:** these comments explained teachers' concerns that cross-curricular assessment may be harder for students to excel in. **Outcomes:** these comments related to experienced or perceived positive (2) and negative (3) effects on learner outcomes. **Engagement:** these comments related to experienced or perceived positive effects on student engagement. **General:** this comment mentioned the importance of considering student voice.	4 5 2 1
Other (n=3)	These comments related to survey structure and questions.	3

On close inspection of the written responses to this section, it is clear that teacher issues were the greatest concern. This is not surprising as the questionnaire is dedicated to teachers' opinions. The greatest concern teachers had with cross-curricular assessment is the lack of alignment between standards of different subjects in NCEA:

- "When people have suggested it in the past, often the criteria of the 2 different assessments are at too much odds to each other so although the students could do both together as one piece of work it ends up that they struggle to score well against both criteria as each is looking for such different things."
- "It depends so much on what subject you can go cross-curricular in and having AS that can be assessed PROPERLY in both areas. E.g., Level 1 Physics and Level 1 Maths AS are still a poor fit. And if Chemistry go cross curricular with art I cannot see how at a Senior level anything we currently teach / assess has meaningful overlap."
- "In my experience, science and physics standards are so prescribed and contain such niche, narrow concepts that aligning them with other learning areas is difficult."

This is closely followed by issues of teacher co-operation, either by lack of willingness to try something new or lack of opportunity to collaborate:

- "The key to cross curriculum work is time and relationships. the teachers need to be able to freely discuss and reflect with one another and they need the time to do this openly and honestly without fear of put downs etc"

- "Trying to find a fit with other teachers topics/time. Depends sometimes on your timetable. Depends on your department - are they getting the dept to do all the same standards, are they all ready to try something new?"

Teacher confidence was also a concern:

- "I would love to do it, but have no idea where to start."
- "We had some confusion when the time came to mark the standard... This unsettled staff and using hindsight better planning will be required to improve the process next time."

Research question two: What are the barriers to assessing more than one standard with a single project?

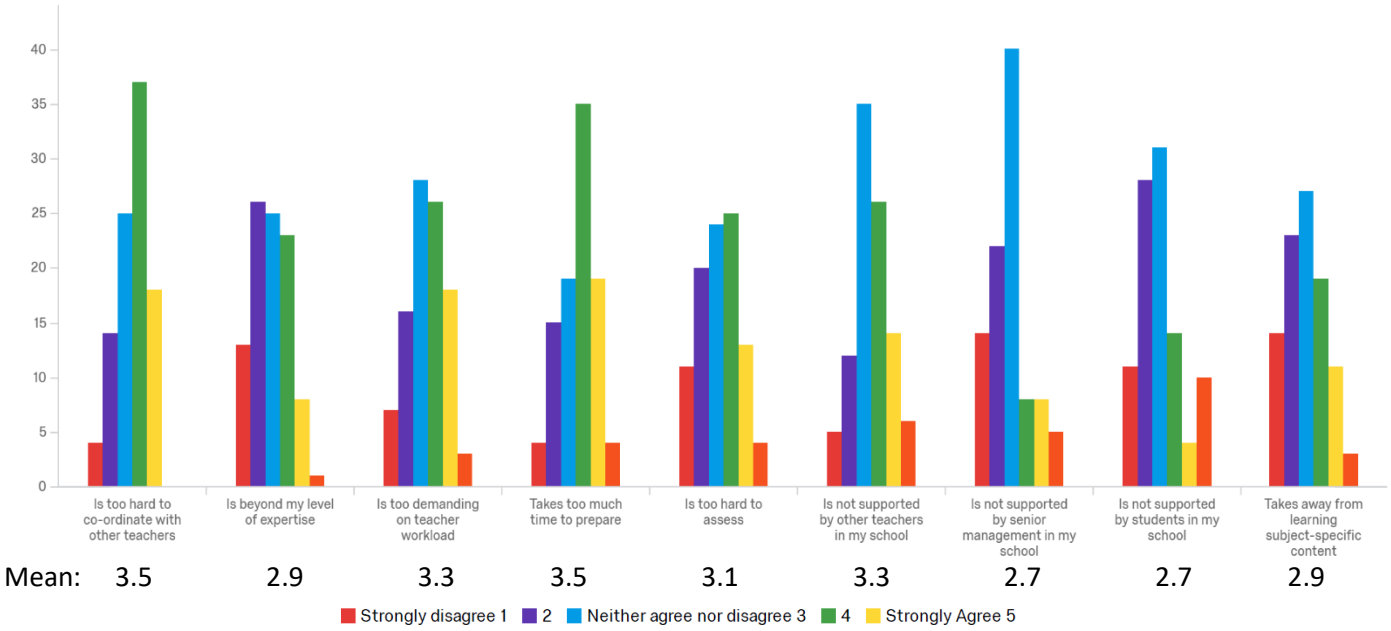

Figure 6. Barriers to assessing more than one standard in a single project.

The major barriers to assessing more than one standard in a single project (determined by highest numbers of positive responses) were: *Is too hard to co-ordinate with other teachers* (55 out of 98); and *Takes too much time to prepare* (54 out of 98). Overall, respondents did not agree that they lack necessary expertise to use cross-curricular assessment (only 31 positive responses out of 96). This section also returned the highest number of "Don't Know" responses, with 10 participants unsure of student voice, six unsure of senior management support, and five unsure of teacher support.

Analysis of this section of the questionnaire was carried out in the same way as the previous section, to determine if the barriers affect different groups of teachers in different ways.

Table 6. Mann-Whitney U test of difference of means for barriers to cross-curricular assessment between teachers with previous experience of cross-curricular assessment (PE) and teachers with no previous experience (NPE)

Statement	Mean rating by previous experience ($\bar{x}$)		p-value
	PE	NPE	
Is too hard to co-ordinate with other teachers	3.3 (n=29)	3.6 (n=65)	0.150
Is beyond my level of expertise	2.5 (28)	3.1 (64)	0.032*
Is too demanding on teacher workload	2.7 (29)	3.6 (62)	0.001**
Takes too much time to prepare	3.1 (28)	3.8 (61)	0.022*
Is too hard to assess	2.5 (28)	3.4 (61)	0.003*
Is not supported by other teachers in my school	3.1 (27)	3.4 (61)	0.358
Is not supported by senior management in my school	2.2 (27)	2.9 (61)	0.012*
Is not supported by students in my school	2.1 (26)	2.9 (58)	0.000***
Takes away from learning subject-specific content	2.4 (28)	3.1 (62)	0.034*

** p-value of less than 0.05; ** p-value of less than 0.01; *** p-value of less than 0.001*

Previous experience had a positive effect on teacher perceptions of barriers to cross-curricular assessment in the areas of teacher expertise and workload, assessment issues, school support and subject integrity.

Table 7. ANOVA of difference of means for barriers to using cross-curricular assessment between years teaching groups

Statement	Mean rating by years teaching ($\bar{x}$)				p-value
	1-9	10-19	20-29	>29	
Is too hard to co-ordinate with other teachers	3.5 (n=30)	3.6 (n=42)	3.2 (n=17)	3.7 (n=9)	0.581
Is beyond my level of expertise	3.0 (29)	2.8 (40)	2.7 (17)	2.9 (9)	0.891
Is too demanding on teacher workload	3.3 (29)	3.3 (40)	3.2 (17)	3.9 (9)	0.522
Takes too much time to prepare	3.5 (28)	3.5 (39)	3.6 (17)	3.8 (8)	0.813
Is too hard to assess	3.1 (28)	3.0 (39)	3.0 (17)	3.8 (9)	0.440
Is not supported by other teachers in my school	3.5 (30)	3.4 (40)	2.9 (14)	3.1 (8)	0.146
Is not supported by senior management in my school	3.0 (29)	2.7 (40)	2.3 (15)	2.9 (8)	0.352
Is not supported by students in my school	2.6 (26)	2.8 (37)	2.4 (16)	3.1 (9)	0.459
Takes away from learning subject-specific content	3.0 (29)	3.0 (39)	2.9 (17)	3.0 (9)	0.909

Years teaching had no significant impact on teacher perceptions of barriers to cross-curricular assessment.

Written responses:

Again, an open-ended question was included at the end of the section: *Are there any other barriers to using cross-curricular assessment of science Achievement Standards that are not listed above? Please list them here:*

There were 33 responses to this question. This time, sentiment analysis was not carried out due to the nature of the question: it was expected that all responses would lean towards the negative. Responses were coded using the same categories as the previous open-ended question, with the addition of a section for school issues. Most subcategories were also maintained, as can be observed in the table below:

Table 8. Summary of written responses to questionnaire section two.

Issue	Responses	Number of responses
Workload (n=4)	Increase or perceived increase in workload for teachers (2) and students (2)	4
Teacher issues (n=31)	This category was divided into the following subcategories: • **Time**: lack of time available to teachers or increase in time required to prepare cross-curricular courses and/or assessments. • **Discomfort:** other teachers' perceived lack of confidence with cross-curricular assessment. • **Co-operation:** encapsulates both lack of teacher willingness to participate in cross-curricular assessment and difficulties with co-ordinating teachers to work collaboratively for cross-curricular assessment. • **Knowledge:** teacher's lack of knowledge of subjects other than their specialist area and/or grade boundaries for assessment. • **Support:** teachers' needs for support both with implementation of new assessments and subject-specific professional development. • **Subject integrity:** concern that specialist knowledge from their subject will be lost. • **Interest:** expressed interest in cross-curricular assessment, on the proviso it could be achieved successfully.	 8 1 10 5 5 1 1
Student Needs (n=8)	• **Time:** perceived increase in class and homework time to complete assessment tasks. • **Difficulty:** concerns that combining tasks will be too difficult for some students and/or may make assessment harder for all students. • **Engagement:** issues with students already being disengaged and lacking motivation to complete project independently. • **Preference:** students may not want to combine subjects and their course selection may not allow for it.	1 4 1 2
NCEA restrictions (n=8)	• **Standard alignment:** issues with co-ordinating requirements and grade boundaries for standards from different subject while maintaining meaningful learning.	4

	• **Changes:** lack of certainty about future standards increases difficulty and reluctance for teachers.	2
School Issues (n=10)	• **Finance:** may be expensive to run cross-curricular programmes. • **Timetabling:** difficulties co-ordinating year and week plans to combine subjects. • **Department co-operation:** difficult to get a whole department and more than one department working together.	2 6 2
Other (n=2)	• **Parents:** may be concerned that cross-curricular learning is too different from what they did at school. • **Survey:** issue with survey design.	1 1

Of the 33 comments provided in this section, the barrier most often mentioned was collaboration between teachers. Within this category, problems both with the logistics of getting teachers from different subject areas together and with teachers being unwilling to co-operate were raised:

- "Getting other teachers to think outside the square and not approach it negatively."
- "Finding an online space to work co-operatively with other curriculum areas is difficult with all of the meetings happening each day. This is a huge barrier for us at Te Kura, it's not that we don't want to do this, it is just that there are regional considerations, national groups (curriculum areas), local meetings (smaller offices within regions)."
- "It is more likely to require departmental cooperation, not just teacher cooperation. It would also be challenging to coordinate curriculum timelines across departments to get two departments to work on a shared unit at the same time."

Issues of time were second-most frequently mentioned, with eight comments explicitly stating time as a barrier:

- "As long as time is allocated if 2+ subject areas are combined to allow for skills from both areas are learnt. Planning & collaboration takes more time."
- "Time allocated to allow teachers to meet and plan cross-curricular lessons /assessments"
- "Time: preparation, rehearsal, etc. Would this require more class time? would this increase the amount of work needed out of class? How long would it take to perform/mark/moderate?"

Issues that arose from this section that had not been allowed for in the questionnaire were: co-ordination of teachers and departments, parental concerns, financial constraints, and restrictions of NCEA standards and assessment procedures. Eight comments pertained to restrictions imposed by NCEA:

- "The specific requirements of the current NCEA internal assessment standards for science (and Maths) are sufficiently specific that it is very difficult to combine assessments with

humanities subjects in ways that don't simply double the complexity, and therefore jeopardy, of these assessment for students."

- "Potential barrier with changes to NCEA from 2021; depends on how things are structured and implemented."

Even though frequency of "other" barriers was low, they still provide insight into impediments to innovative assessment methods in NCEA science:

- "The problem is getting your head around the other learning area so you can co-create a coherent and meaningful learning experience for the students. Each teacher needs to have a level of understanding of the other learning area that enables them to see the opportunities for their own learning area to naturally fit in and be distinct. The science learning area has created NCEA standards that are so content-heavy, that it is a very big challenge to find ways to bring that content out in other learning area contexts. Not all teachers have the confidence or experience to do this. That's why it's not common practice."
- "Timetabling, planning constraints, student course selection, teacher knowledge of other subjects (I could include maths standards, but have no idea on English for example!)"
- "Teachers will need to [be] trained. There is also the consideration that science curriculum time will be given to other areas."

Research question three: What do teachers need to overcome barriers to be able to use cross-curricular assessment for science and arts in NCEA?

Teacher professional development interest:

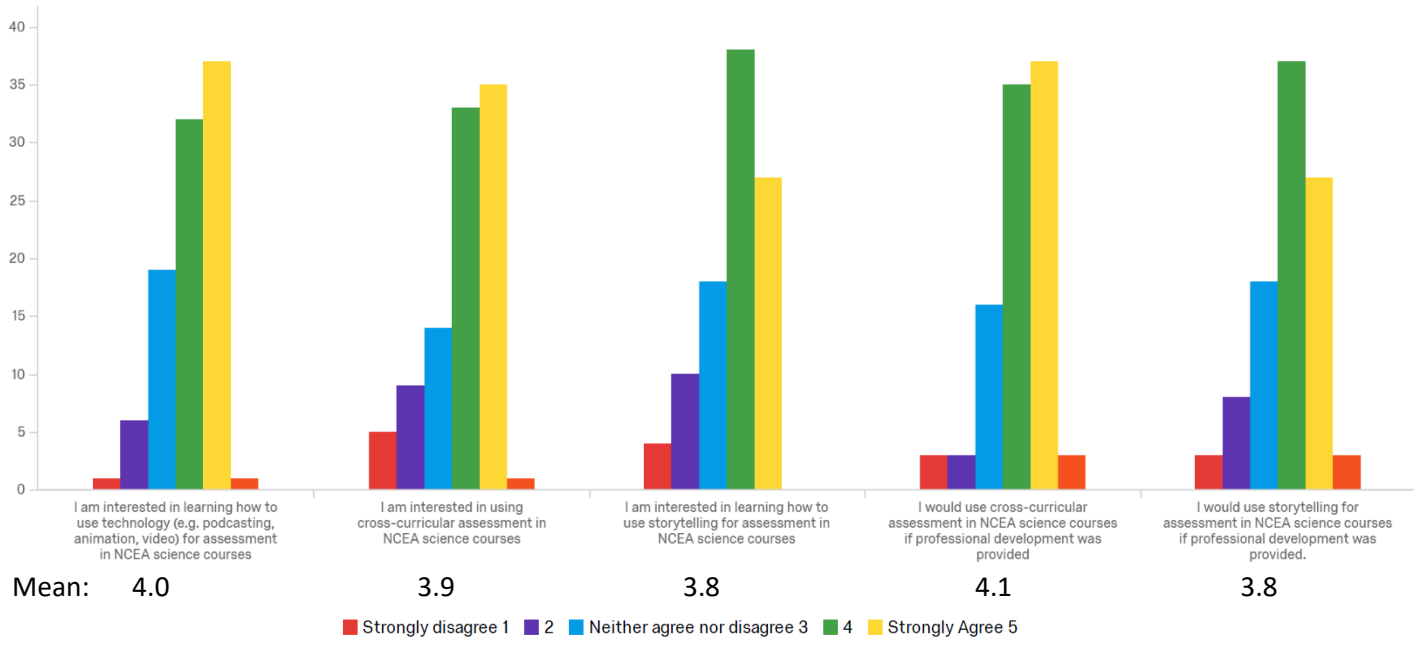

Figure 7. Teacher professional development interest levels.

In general, the teachers who responded to the questionnaire were interested in professional development opportunities, particularly for cross-curricular assessment. Again, these data were analysed using Mann-Whitney U testing and ANOVA to determine any relationship between professional development interests and: previous experience, and years teaching. Region was also included in the analysis to determine if professional development could be targeted to a particular area of the country, but no statistically significant difference was found between regions for any of the items in this section.

Table 9. Mann-Whitney U test of difference of means for interest in professional development between teachers with previous experience of cross-curricular assessment (PE) and teachers with no previous experience (NPE)

Statement	**Mean rating by previous experience ($\bar{x}$)**		**p-value**
	PE	**NPE**	
I am interested in learning how to use technology (e.g. podcasting, animation, video) for assessment in NCEA science courses	4.0 (n=28)	4.0 (n=64)	0.826
I am interested in using cross-curricular assessment in NCEA science courses	4.3 (28)	3.7 (64)	0.019*
I am interested in learning how to use storytelling for assessment in NCEA science courses	4.0 (28)	3.6 (65)	0.194
I would use cross-curricular assessment in NCEA science courses if professional development was provided	4.2 (28)	4.0 (62)	0.226
I would use storytelling for assessment in NCEA science courses if professional development was provided	4.0 (26)	3.7 (63)	0.317

** p-value of less than 0.05*

Teachers with previous experience of cross-curricular assessment were more interested in using cross-curricular assessment in NCEA science courses than those without. There were no significant differences between groups for all other items, with all mean ratings on the positive side of the scale, indicating that teachers surveyed are interested in professional development.

Table 10. ANOVA of difference of means for interest in professional development between years teaching groups

Statement	**Mean rating by years teaching ($\bar{x}$)**				**p-value**
	1-9	**10-19**	**20-29**	**>29**	
I am interested in learning how to use technology (e.g. podcasting, animation, video) for assessment in NCEA science courses	4.2 (n=29)	3.9 (n=40)	4.2 (n=17)	3.7 (n=9)	0.357
I am interested in using cross-curricular assessment in NCEA science courses	4.1 (30)	3.8 (40)	4.2 (17)	3.0 (9)	0.002**
I am interested in learning how to use storytelling for assessment in NCEA science	3.7 (30)	3.8 (41)	4.1 (17)	3.2 (9)	0.062

courses					
I would use cross-curricular assessment in NCEA science courses if professional development was provided	4.4 (28)	3.9 (40)	4.2 (17)	3.7 (9)	0.119
I would use storytelling for assessment in NCEA science courses if professional development was provided	3.9 (28)	3.9 (39)	3.9 (17)	3.3 (9)	0.426

*** p-value of less than 0.01*

Years teaching had a negative effect on teacher interest in using cross-curricular assessment in NCEA science courses. Teachers in the >29 years group were less interested than those with fewer years' teaching experience. However, all mean ratings were on the positive side of the scale, indicating all years teaching groups were interested in professional development.

Professional development preferences:

Participants were asked to indicate their preferred professional development formats. They could select more than one option from the list and were not asked to rank their choices. For this reason, statistical analysis beyond reporting the mode was not carried out. Suggestions for the "other" category did not include any ideas from outside the list provided, rather guidance on how some of them could be delivered to be effective.

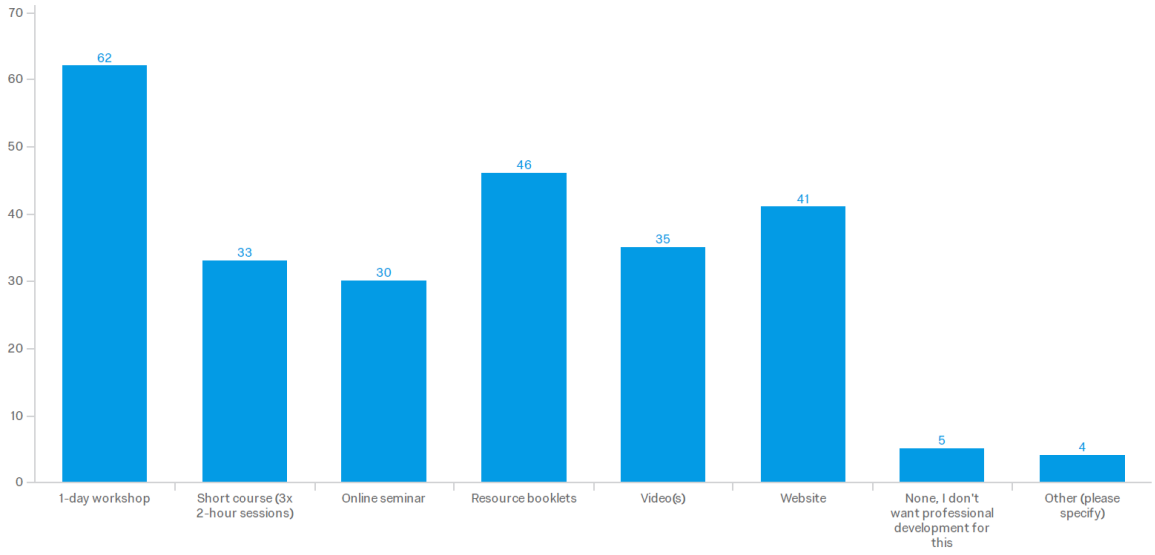

Figure 8. Teacher professional development preferences

The most frequently requested were a 1-day workshop, resource booklets, and website. These three formats will, therefore, be combined for the creative project.

Professional development timing preferences:

Table 11. Teacher professional development timing preferences.

Time of Year	During term time (November-December) 73	Summer school holidays (January) 4	During term time (February-March) 15		Other 2
Time of week	School day 76	Weekend 2	Evening during the week 15	Evening at the weekend 0	Other 2

Again, the mode was used to analyse responses to this item. There is no arguing that the most popular option for professional development was a school day during term time in November-December.

Written responses:

A final opportunity for comment was given at the end of this section with the question: *Is there anything you would like to share that you think has not been addressed by this questionnaire?*

Many responses related to professional development opportunities, with teachers elaborating on their preferences and highlighting issues not accounted for in the previous questions. Several respondents raised issues not previously mentioned in the questionnaire and some took the opportunity to voice concerns with question structure.

New codes were established for this section. Categories for comments relating to professional development, and general comments were added. Teacher issues was maintained with a few changes to subcategories.

Table 12. Summary of written responses to questionnaire section three

Issue	**Responses**	**Number of responses**
Professional Development (PD) (n=15)	This category was divided into the following subcategories: • **Timing:** suggestions for the best time for running a PD workshop. • **Issues:** concerns with attending PD, including cost to school and/or accessibility for teachers in isolated locations. • **Support:** need for support of teachers including follow-up after workshop. • **Resources:** desire for resources to be provided and/or developed during workshop/course	 4 4 5 2
Teacher issues	This category was divided into the following subcategories:	

(n=15)	• **Time:** amount of time needed to prepare resources and/or attend PD. • **Co-operation:** both positive and negative statements relating to need to collaborate with other teachers. • **Discomfort:** personal difficulty with arts content. • **Technology:** teacher competence with use of technology and/or issues with student behaviour with technology. • **Implementation:** need for support from middle and senior management to establish cross-curricular assessment in school.	2 3 1 4 5
General comments (n=4)	• **Survey issues:** one school did not fit the categories provided; one teacher took issue with combining cross-curricular assessment and storytelling in the questions. • **No:** respondents merely wrote "no" in reply to the question.	2 2

Issues that had not been addressed in the questionnaire that arose were: financial and practical constraints of attending professional development workshops, need for ongoing support from within the school for innovation, and current teacher competence with technology.

Once again, the written responses provided valuable insight that could not have been gleaned from the Likert-type questions alone. Many of the responses gave advice on PD delivery:

- "It is important to give pd on this BEFORE the year gets underway. I am more than happy to use holiday time or after seniors go or evenings to reduce the impact on not being with my seniors. I do a lot of my planning in January so Feb-March is too late."
- "It is so hard to have PD when we are in regional areas. It costs money and therefore schools don't want to spend money for subject specific areas."
- "I think it's a great idea but unless the course leaves teachers with a ready to use resource then I would be unlikely to implement anything even after attending the course. It would be great if a resource was also made for use in year 10, because then we can practice and get used to it but without jeopardising our seniors' grades."
- "Offering follow up support and guidance to ensure teachers participating are able to develop their own resources."

2.4 Questionnaire Discussion

The purpose of this online questionnaire was to determine the attitudes of NCEA science teachers to use of cross-curricular assessment combining arts and science standards, with storytelling as a vehicle for this. Also, barriers to using these methods and professional development needs were addressed in the hopes of finding solutions to enable teachers to assess their subject in innovative

ways. Results of this questionnaire were then used in combination with findings from the interviews to inform the creative project of this thesis.

Before embarking on a discussion of the results of the questionnaire and their implications, it is necessary to address its limitations. Firstly, response rate for this questionnaire was not as high as was desired, and it has already been pointed out that this is not a representative sample of science teachers from New Zealand. Although low with only 111 total completed surveys (including several incomplete submissions), responses still provided crucial information on the needs and opinions of teachers interested in creative cross-curricular assessment. Arguably, as this research is for their benefit anyway, even a small number of respondents is useful. In addition, the small sample number is justified by the use of mixed methods for this study. Interviews were also carried out to support the findings of the questionnaire.

It is also important to clarify language used henceforth. The fact that this survey is not generalisable to the entire NCEA science teaching population of New Zealand has already been addressed. However, for ease of interpretation and discussion, this sample will be referred to as "teachers".

Research question one: What do teachers think about cross-curricular assessment of science and arts in NCEA?

Overall, teachers were positive about cross-curricular assessment in NCEA science. Although there was interest in using storytelling as a technique for assessment—with a higher number of positive responses than negatives—it was not as strong as that for cross-curricular assessment. It is difficult to know for sure whether these teachers were positive about assessing science and arts together or just about combining standards from different science-based subjects. Examination of the responses to the open-ended question from this section give some clarification on this, with only eight out of 23 comments explicitly discussing combining science-based standards. A much clearer result from this section was the lack of confidence teachers have in using cross-curricular assessment for NCEA science, with only 28 out of 96 responses in the "Agree" or "Strongly Agree" categories (less than one third).

When analysing the data in more depth, there were significant discrepancies in attitudes between different groups of teachers. Unsurprisingly, teachers who had previous experience with cross-curricular assessment (PE) were far more positive about it than those who did not (NPE), supporting the first hypothesis of this study. These teachers were significantly more interested, confident, and likely to use cross-curricular assessment. Interestingly, there was no statistically significant

difference in interest in storytelling between this group and the group with no previous experience of cross-curricular assessment.

There was some evidence to support the second hypothesis of this study: that number of years teaching is a significant factor in teacher attitude towards cross-curricular assessment. Teachers who had been teaching for more than 20 years were significantly less willing to try a variety of assessment approaches. Teachers of over 29 years' service were significantly less interested in both cross-curricular assessment and storytelling for assessment, indicating that perhaps old dogs and new tricks do not mix. Years teaching did not influence confidence or likelihood of using cross-curricular assessment.

These findings are supported in the literature by Osbourne's (2014) discussion of the ideas of *technical* and *adaptive change* as proposed by Heifetz, Grashow, and Linsky, (2009). When an individual is required to change their usual practices in the workplace, they will most likely be required to undergo one of these two change processes. A technical change requires only small adjustments to usual methods and aligns with a person's current beliefs and values. For example, a teacher in the PE group would undergo technical change to incorporate other creative methods into their assessments. This may explain the apparent openness to creative assessment from this group. On the other hand, adaptive change requires a shift in mindset and challenges the beliefs and values of the individual (Osbourne, 2014). It requires investment of time and energy to learn new skills and implement them, which can come at a cost to one's security: "As people try to develop new competencies, they'll often feel ashamed of their incompetence." (Heifetz et al., 2009, p. 64). This could partly explain the reluctance of both the NPE and longer serving teacher groups to implement creative assessment methods. Osbourne (2014) goes on to discuss the sense of loss an established teacher may feel at having to change their approach to teaching and learning, noting that the longer a teacher has had to develop and reinforce their philosophies, the harder this may be for them. "If people have a lot of themselves invested in the old way of doing things, it's understandable they feel a sense of loss when that old way comes to an end. The more invested; the greater the loss." (p.4).

When analysing teacher attitudes towards student outcomes using cross-curricular assessment, again the outlook was generally positive. The most contentious category here was the possibility of a decrease in student workload. Once again, previous experience increased the positivity of responses, with all items in this section returning a mean of 4.0 or above from this group. The only category not following the trend of PE being more positive than NPE was "*Can increase student engagement*" in which both groups responded positively.

Once again, the longest serving teachers were the most negative in this section, with teachers of over 20 years' experience having the lowest ratings for student learning, and reflection of the real world. The >29 years teaching group was alone in their negative view of student achievement and teacher enjoyment: they did not agree that cross-curricular assessment of arts and science can improve student achievement or is more enjoyable for teachers. There was not a clear division between experienced and new teachers for either teacher attitudes or teacher attitudes towards student outcomes. Teachers of 1-19 years' experience were most positive about student engagement but did not consistently rate items more positively. Although it appears that the most experienced teachers were the least positive about creative cross-curricular assessment, the reverse cannot be stated with confidence. That is, the least experienced teachers were not necessarily the most positive.

In a nutshell, teachers were positive about cross-curricular assessment, interested in using storytelling to do this and apprehensive about how it could be successful under NCEA both with the current system and with the imminent reboot.

Research question two: What are the barriers to assessing more than one standard with a single project?

Responses to section one touched on some of the issues that teachers are faced with when considering cross-curricular assessment methods. The second section investigated the extent of the effect of barriers most commonly appearing in the literature on cross-curricular assessment. Two questions arose from examination of the literature: are the barriers identified reflective of the perceptions and experiences of teachers? Are different groups of teachers affected differently by these barriers?

Overall, the biggest barriers to use of cross-curricular assessment were teacher co-ordination/co-operation and preparation time. However, the results of this questionnaire did not show any serious agreement or disagreement with any of the barriers listed. There are three possible reasons for this:

1. The sample size of the study was too small. This has been mentioned at least once already. Of course, this was not a study of national consequence (it did not have the might of the Ministry of Education behind it) and it did not claim to be. It may be that the sample was too small for generalisations, but one must work with what one has.
2. The barriers listed in the questionnaire did not fully describe barriers faced by teachers. This is of course possible, but much care was taken in the design of this questionnaire to ensure it accurately covered real issues in teaching.

3. Over two-thirds of the respondents to the questionnaire had not previously used cross-curricular assessment for NCEA science. This means that many of these teachers were responding to questions they may not have previously considered, and it is likely their responses were guesses. Many of them were not willing to do this as was evident with the number of "Don't Know" responses, as well as "Neither agree nor disagree". It is important for this study to find out why these teachers had not yet tried cross-curricular assessment. However, it is also important to note the difference between the perceptions of the inexperienced and the realities of those who have braved innovative practices.

Previous experience again had a positive effect on the perceptions of respondents, further supporting hypothesis one. For issues of professional expertise, teacher workload, difficulty assessing, and detracting from of subject-specific knowledge, teachers in the PE group disagreed that these were barriers, whereas NPE teachers rated these on or slightly higher than "neither agree nor disagree" that is, they did not disagree with this. Both groups disagreed that lack of student and management support of cross-curricular assessment were barriers, but PE disagreed significantly more.

Years teaching had very little impact on teachers' perceptions of barriers to cross-curricular assessment. The only barrier that showed significant division of opinion between teachers of over 20 years' experience and those with fewer was teacher support. In this instance, the more experienced teachers disagreed that other teachers in their school did not support cross-curricular assessment. This finding suggests that experience did not have a significant impact on teachers' perceptions or experiences of issues with cross-curricular assessment, so does not support hypothesis two.

Because there was little clear agreement with the barriers listed in the questionnaire, inclusion of the written responses was required to provide further elucidation. The two most frequently mentioned issues were teacher collaboration and time. Comments relating to these two categories expanded on what was already in the questionnaire. It may have been that the items to choose from were too narrow to accurately reflect teachers' views of barriers to cross-curricular assessment. So, although time was included as a barrier, it was in the context of preparation only and did not allow for other time-consuming activities such as carrying out the task in class and marking and moderation of assessments once complete.

Written responses also highlighted barriers not on the questionnaire. Restrictions imposed by NCEA, teacher knowledge and support, timetabling and school-wide co-ordination made appearances.

Interestingly, though teachers generally disagreed that lack of expertise was a barrier for them, several did comment that they would need help to understand other subject areas.

The only significant teacher attribute in perceptions of barriers was previous experience of cross-curricular assessment. Teachers in the PE group were less inclined to agree that each issue listed was a barrier to this assessment method. Perhaps this suggests that cross-curricular assessment is a case of "don't knock it till you've tried it" and once you have, it is difficult to revert to old practices. It may be that perceived issues (or fear of facing these) are enough to put teachers off. Johnson's (2011) study of two middle-school Science teachers in the U.S.—who participated in a long-term professional development programme to tailor their teaching methods to the diverse learners in their classes—reinforces this notion. One of the teachers in the study discovered that when he made the effort to try a new approach that included families of his learners in their education, his previous beliefs were incorrect: "he learned many of the barriers were non-existent in reality" (Johnson, 2011, p. 184). The other notable finding from this study was that once this teacher had invested the time and effort to change his approach to teaching, he could not envisage reverting to his previous practices. It is likely that once a teacher has overcome the initial hurdle of investing time and energy in implementing creative assessment methods they will not want to go back to their previous methods. My personal experience also supports this idea. Teaching online during a global pandemic and being forced to revert to assessment via written reports grated significantly with my philosophy of teaching and learning. Having used creative assessment methods at the beginning of the year, it hurt to have to compromise student achievement for ease of getting the task completed remotely in place of using assessment methods better suited to individual strengths.

Defining barriers encountered by teachers when considering use of cross-curricular assessment is complex. Every teacher is affected differently by the challenges of the profession. Much of a teacher's experience is a product of the culture of the school they are teaching in and the people they have around them. Every teacher's reality is different from the next, so applying a list of barriers to the whole population would be inconsiderate. However, responses to the questionnaire—clarified by the written responses—narrowed the major categories of barriers to time, teacher co-operation and restrictions imposed by the nature of NCEA.

Research question 3: What do teachers need to overcome barriers to be able to use cross-curricular assessment for science and arts in NCEA?

Now that it has been established that there are barriers to using cross-curricular assessment amongst NCEA science teachers it needs to be determined if they can be overcome. The purpose of this

section of the questionnaire was to determine how best to deliver professional development (PD) for teachers and to inform the content of the creative project.

Firstly, teacher interest in PD opportunities was gauged. Generally, teachers were interested in participating in PD programmes to upskill in use of technology, cross-curricular assessment and use of storytelling techniques. Most popular was PD for use of technology.

There was very little statistically significant difference between groups for this section. Previous experience only had a slight effect on teachers' interest in PD for cross-curricular assessment, with the PE group more interested than NPE. Years teaching played a significant role in interest in cross-curricular assessment and storytelling, with 20-29 showing the most and >29 the least. It could be that teachers in the 20-29 years' experience group were looking for ways to freshen up their teaching and were sufficiently confident with content for this, or that these teachers were more often in positions of leadership and looking for ways to improve their departments.

Following expressions of interest, the questionnaire sought to find out the most popular method of delivery for PD programmes. A one-day workshop was by far the most frequently selected method of delivery, closely followed by resource booklets and online resources. This is supported by Timperley et al., (2007), who note the popularity of one-off professional learning for teachers in New Zealand. They argue, however, that this is not the most effective form of PD for teachers: "deeper learning typically requires repeated cycles of engagement with learning processes, practice, and outcomes" (Timperley et al., 2007, p. 8). However, if a workshop is supplemented with ongoing support in the form of mentoring and resourcing, it may be effective (Arrowsmith & Wood, 2015). Unsurprisingly, the best time for a workshop was voted as a school day in November or December (when teacher contact time is lowest, because senior students are on exam leave). Due to unfortunate timing of this study, it was not possible to deliver a workshop at this time as the creative project, but there is the potential for this to stem from the initial workshops conducted in Term One 2020 at Otago Boys' High School.

Could professional development be the answer to the issues faced by teachers interested in using creative cross-curricular assessment for NCEA science? It may not be able to solve the issues of timetabling and teacher co-ordination within schools, but it certainly can go a long way to removing the barriers of lack of teacher confidence and knowledge of other standards, and time needed to prepare resources. The results of the questionnaire provided some answers to the research questions posed above, and some evidence to support the two hypotheses of this study, but they were not enough on their own. Therefore, interviews were conducted with teachers of NCEA science

courses to support the findings of this part of the study and to further clarify the needs of science teachers for innovative assessment to tailor resourcing to the target audience.

Chapter 3: Interviews

3.1 Introduction

The second phase of this research was to conduct semi-structured interviews with individual teachers. The reason for using this process was to gain qualitative data to strengthen the insights gained from the questionnaire, as participants had increased freedom to share their opinions and experiences (Atkins & Wallace, 2015). The two major advantages of this technique are: that the interviewer has the ability to explain questions or terms if the interviewee is confused; and that the conversation can be led in various directions, depending on the responses given to the questions (Bell & Waters, 2014).

3.2 Methodology

Where possible, the interviews took place in person in a location that was familiar and comfortable for the interviewee (Atkins & Wallace, 2015). Those that could not be done in person were conducted over Zoom at a time determined by interviewees. Interviews were recorded and transcribed, and content analysis was carried out to discover any themes apparent across the interviews.

A combination of convenience, snowball, and volunteer sampling was used to select candidates for the interviews. Convenience sampling, also termed accidental or opportunity sampling, involves "choosing the nearest individuals to serve as respondents and continuing that process until the required sample size has been obtained." (Cohen et al., 2011, p. 155). Snowball sampling uses these participants to provide the researcher with access with their contacts who may fit the requirements of the study (Cohen et al., 2011). Two colleagues were selected as initial interview candidates and one of these used her contacts in the Biology teaching sphere to provide two more interviews. Gaining access to teachers who fitted the required criteria of teaching science and using NCEA assessment tasks proved to be challenging, so volunteer sampling was employed after the initial selection of interviewees (Cohen et al., 2011). Volunteer sampling is seen as a last-resort option, as these participants must either be interested in the study being conducted, or have a relationship with the researcher in which they want to support their efforts (Cohen et al., 2011). Despite its obvious shortcomings with regard to generalisability, Morrison (2006, p.175) justifies volunteer sampling: "it is maybe better to have this kind of sampling than no research at all." (Cited in Cohen et al., 2011, p. 160). As with the questionnaire, an advertisement was placed on the NZST, NZPT, and CoMPaSS PLG Facebook groups and another six teachers volunteered using this forum, of which four

completed interviews. One of these teachers then provided further contacts and another three interviewees volunteered (however one of these interviews never eventuated). In total, 13 interviews were conducted with teachers from a variety of locations, ranging from Auckland to Dunedin.

Design of the interview schedule was carefully considered to ensure the interviews ran smoothly and that data obtained were relevant and valuable to the aims of the research. The sequence of the questions to be asked was planned in accordance with the advice of Cohen et al., (2011) who recommend that, "easier and less threatening, non-controversial questions are addressed earlier in the interview in order to put respondents at their ease." (p. 423). Atkins and Wallace (2015) elaborate on this advice to suggest that questions beginning with 'Tell me about…' (p.88) are a good place to start. For this reason, the first question on the interview schedule was: *Can you tell me a bit about your school?* The schedule itself consisted of three warm-up questions pertaining to the interviewees' teaching experience, followed by seven questions focused on the research objectives (See Appendix D for full interview schedule). The interview schedule comprised both open- and closed-ended questions and inclusion of prompts and probes if needed (Cohen et al., 2011). The schedule was followed for all interviews to minimise possible bias, ensuring that all interviewees responded to the same questions (Atkins & Wallace, 2015). The semi-structured nature of the interviews allowed for rapport to be built and maintained with respondents and gave a clearer picture of the respondents' views (Cohen et al., 2011).

Each interview was conducted in accordance with the University of Otago Higher Education Development Centre's guidelines (Nairn, n.d.). Participants were sent an information sheet including a consent form to be signed before confirmation of interview time (See Appendix B for full ethics information). Respondents were given the choice of when the interview would take place, and some made use of an online booking site for this. At the beginning of each interview, consent was verified and if the form had not been returned (as was difficult with interviews taking place over Zoom) then consent was given verbally on the interview recording. Before recording commenced, each interviewee was informed of how the interview would be structured, what would be done with the recording and transcript, that they were within their rights to decline to answer any questions, could opt out at any stage, and assured their anonymity would be maintained (Cohen et al., 2011; Nairn, n.d.). Permission was sought before recording any interview and interviewees were informed once recording had begun. Only two interviews were completed in person, and these were recorded on an audio recording device. All other interviews were recorded using the recording capabilities of the Zoom software for simplicity and to lessen possible interviewee discomfort with obtrusive recording equipment (although use of Zoom for the first time had its own complications for some

respondents)(Atkins & Wallace, 2015). Although both audio and video were recorded, only the audio files were used for transcription and analysis so that all interviews were analysed in the same way, thus minimising bias.

Participant comfort was given the utmost importance during the interviews (Atkins & Wallace, 2015; Cohen et al., 2011). This was achieved by building and maintaining rapport with the interviewees throughout the interview process: from email contact beforehand, positive interactions during the interview and follow-up contact after the interview had taken place. As all interviews were carried out with visual links, positive body language was used to encourage the interviewees in their responses and to avoid cutting them off, or influencing their responses by paraphrasing too soon (Cohen et al., 2011). Recording the interviews meant that I could give respondents their undivided attention and helped to keep them at ease by not writing as they were speaking (Atkins & Wallace, 2015; Check & Schutt, 2012). Kept in mind throughout the process was the idea that, "It is important for the interviewer to render the interview a positive, pleasant and beneficial experience, and to convince the participant of their own worth and the importance of the topic." (Cohen et al., 2011, p. 424). I made every effort to prevent personal biases and judgement from creeping in—most notably by keeping my own mouth shut and as much as possible—only speaking when asking or clarifying questions (whist maintaining a comfortable level of conversation) (Cohen et al., 2011).

I completed transcription as soon as possible after the conclusion of each interview, following the guidelines provided by Atkins and Wallace, (2015) Each interview was transcribed in parts then listened to as a whole to ensure accuracy of wording and to gauge general tone of the conversation. Only verbal interactions were transcribed, as the purpose of this study was to gain a general overview of teachers' thoughts about creative assessment, not to analyse the teachers themselves (which can open the door to researcher bias and misrepresentation) (Atkins & Wallace, 2015). Although a valid one, the argument for inclusion of non-verbal information was disregarded as it is not essential to this study. It pays then to bear this in mind when analysing the results as, "it is unrealistic to pretend that the data on transcripts are anything but already interpreted data." (Cohen et al., 2011, p. 426).

Following transcription, interviews were summarised by selection of key quotes relating to the main topics of the interview: previous experience, interest in creative assessment and storytelling, barriers to using creative assessment, and professional development needs. These data were then collated and tabulated by issue, to gain an overall picture of the feelings of teachers towards creative assessment for NCEA science (Cohen et al., 2011). Following this, quantitative analysis of responses could be carried out.

Interview Limitations

There are limitations to this study that must be addressed. The difficulty encountered in finding suitable candidates for interviews limited the sample size. Convenience sampling is open to criticism as one person's circle of acquaintances is of course limited by social commonalities. The demographic reached in this way is unlikely to be representative of the whole population and therefore generalisability is low (Cohen et al., 2011). To combat this, snowball sampling was also used, which can generate a much more representative sample after two or three iterations (Noy, 2008, cited in Cohen et al., 2011). However, the reality of a small-scale study is that it will not be representative. Bell and Water's (2014) attitude, "You may be forced to interview anyone from the total population who is available and willing at the time" (p.166) was adopted here. The aim of this study is not to generalise findings to all teachers, but to find relatability for the wider secondary science teaching population in New Zealand (Bell & Waters, 2014) and to identify the range of possible attitudes towards creative assessment in this community. This sample did just that. Another major limitation with conducting interviews for educational research is bias (Atkins & Wallace, 2015; Bell & Waters, 2014; Check & Schutt, 2012; Cohen et al., 2011). Although objectivity is the ideal, it is humanly impossible. Bias can arise in a variety of ways including intonation when asking questions, emphasis on certain topics, leading questions, body language in response to answers to questions, and analysis of interviewee responses, to name but a few (Bell & Waters, 2014). In order to minimise this, questions were carefully designed to minimise potential sources of bias and interviewer conduct was monitored as best as possible (Check & Schutt, 2012). Finally, transcription of conversations has its downfalls. Written words without the intricacies of tone of voice, facial expression, and body language do not convey the full meaning of the conversation (Cohen et al., 2011). This was countered by re-listening to each interview after transcription to ensure the tone was accurately interpreted.

3.3 Interview Results

Demographic information about interviewees and their schools is summarised below:

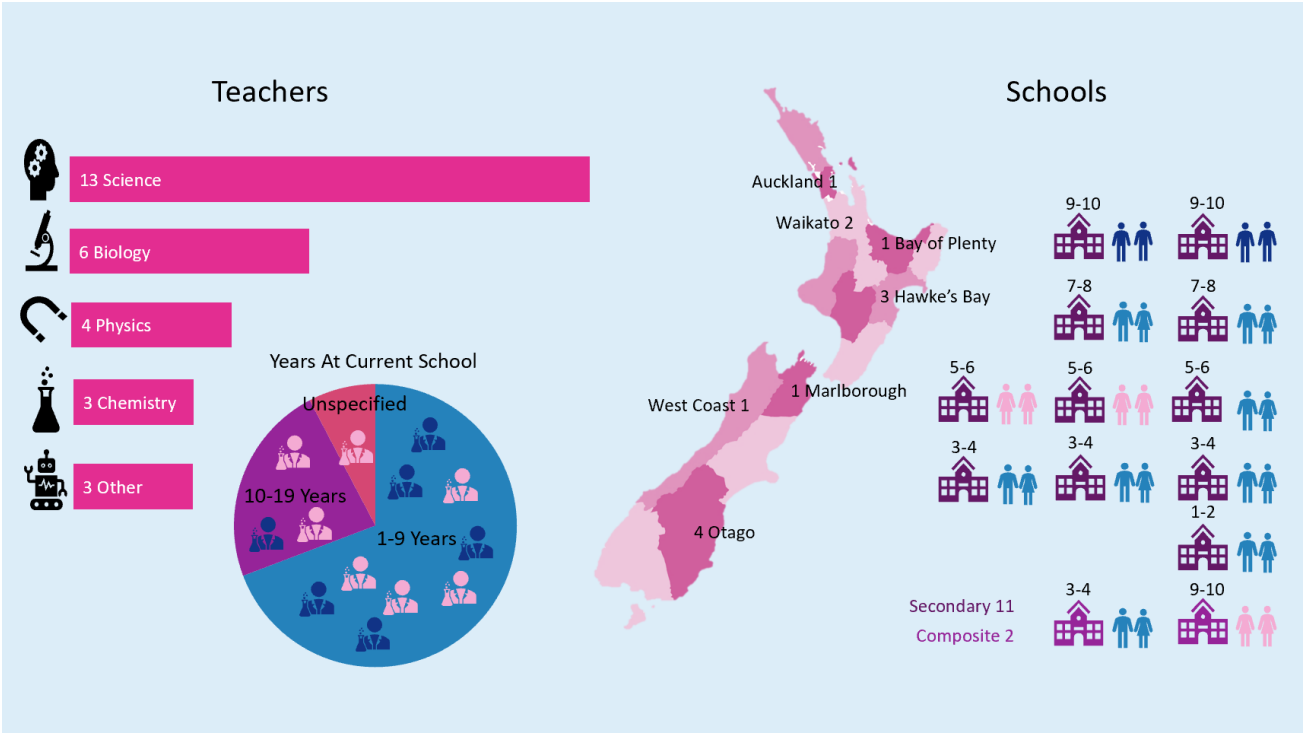

Figure 9. Teacher interview demographic information.

Of the 13 teachers interviewed, seven were female and six were male. Three had been in their current school for over 10 years, nine for fewer than this, and one did not specify. All of them listed Science as a teaching subject, with at least one other supporting subject. A range of schools were also represented, with at least one from each decile band, including one area school and one Kura Kaupapa Māori. Once again, Otago was overrepresented in the sample due to location of existing contacts and my personal convenience.

Interview content was collated into themes and tabulated by issue. (Note: filler words, such as "um" and repetition were omitted from quotes for ease of reading, without changing the meaning of the comments).

Theme 1: Previous experience

Teachers reported mixed experiences with combining standards for NCEA assessment. When working alone to administer both tasks, this was often a positive experience. Negative experiences occurred when trying to co-ordinate two teachers or departments to collaborate. Combining Biology standards for a single assessment was not viewed favourably by the teacher who had tried it, nor by an NZQA moderator.

Table 13. Teacher previous experience of innovative assessment tasks.

Cross-curricular (n=5)	Five of the teachers interviewed had previous experience of combining standards from different subject areas for NCEA assessment: • Teacher 1 (T1) combined a Biology standard with a Maths standard; T4 Biology and Digital Technology; T6 Physics and Art; T7 Biology and English; T12 Physics and Maths. • Of these, T4 and T6 specifically mentioned that this was a positive experience: "the kids loved… being assessed on two different aspects of the task… they felt that they could achieve in the Digital aspect, so therefore it gave them more confidence to give the Science side a go." (T4) "she did a great job… her descriptions were really nice… And the illustration and original artwork she did was great" (T6) • T7 and T12 both stated this was not a positive experience: "it fell over in reality" (T7) "Maths wasn't interested because it wasn't exactly the way they do it" (T12)
Same subject (n=4)	Four teachers had combined standards from the same subject for NCEA assessments: T4 and T5 Biology; T7 and T8 Science. • Only T5 described a negative experience with this: "students got confused about what requirements were for what standard." • T7 and T8 both described positive outcomes: "Probably about two thirds of the class managed to Achieve both, and everyone Achieved at least one." (T8). "…it's easy when you're the teacher in charge of both those things." (T7).
Junior classes (n=5)	Five teachers described previous experience of using creative assessment methods with junior classes. T3 and T4 had used storytelling, T9 and T11 video and other creative methods, T5 had used a cross-curricular project.
No previous experience (n=6)	Six teachers had no previous experience of combining standards for NCEA assessments: • Both T2 and T10 expressed interest in trying this in future. • T13 had been advised against combining two Biology standards by an NZQA moderator: "in most cases it doesn't pass the moderation… when he moderates, he usually finds… there are issues with meeting the criteria for one of the two standards."

Table 14. Summary of interviewee previous experience.

Cross-curricular NCEA assessment	
PE	T1, T4, T6, T7, T12
NPE	T2, T3, T5, T8, T9, T10, T11, T13
Storytelling as a teaching and learning strategy:	
PE	T3, T4
NPE	T1, T2, T5, T6, T7, T8, T9, T10, T11, T12, T13

Theme 2: Current assessment practices

While teachers may have had the best of intentions when it came to creative methods of assessment, it appears that the vast majority of assessment material was handed in as a written piece of work. There is a distinction between creative assessment tasks and creative assessment contexts. Although the context of the task may be unique and innovative (such as inventing a star for students to analyse as T12 did), the method of submission was most commonly written.

Table 15. Current teacher assessment practices.

Written (n=13)	Every teacher interviewed stated or implied that written submission of assessments was the norm: • "while the intention is to use a wide range of mediums, I'd say that writing, reporting using writing is probably the most commonly used." (T1) • "written reports for some of the research tasks, and then the other ones would just be tests." (T9) • "all of our assessments for internals have essentially been written reports." (T13).
Creative (n=3)	Three teachers (T1, T4, T7) encourage use of creative methods of assessment: • "…the students have been really encouraged to use mediums outside of writing, to record as much information as possible but their default is to write." (T1) • "I've done everything from speeches, to producing like a brochure, to… Just even a report…practical ones and then trying to talk through, getting the information we need from it." (T4) • "all my tasks are open-ended. They can do whatever format suits them. I'm trying to encourage more of them to take up that opportunity 'cause right now you get 100% essays. Written reports every single time." (T7) Two teachers (T2 and T6) noted experience of individual students using creative methods to complete assessment tasks: • "this year I did get a stop-motion video handed in." (T2) • "apart from the video it's all been written." (T6) T3 and T12 described creative contexts for assessments, but ultimately these were all written reports: • "we use field trips, where the kids go and look at stuff and then write a report based on what they've looked at" (T3)

Theme 3: Teacher interest in creative assessment methods

Respondent interest in creative assessment was high. However, reservations about the implementation of such strategies were addressed. Interest in storytelling rated less highly with interviewees than did creative assessment methods. Issues that arose were the practicalities of implementing a task using storytelling and concerns that students would get too caught up in the story and miss key requirements of the science task. Overall, the potential for storytelling as a vehicle for creative assessment was well-received.

Table 16. Teacher interest in creative assessment methods.

Creative methods (n=13)	All interviewees showed interest in using creative assessment methods for NCEA science courses, with varying degrees of enthusiasm. Eight teachers (T1, T2, T3, T4, T6, T7) were very interested in using creative assessment methods: • "I am interested in doing this and I think that this is something that will become standard going forward." (T1) • "Yeah, definitely." (T2) • "Yes. Absolutely, yep." (T3) Three teachers (T5, T10, T12) were interested but expressed uncertainty about how it could be achieved successfully: • "I'd like to do it. I've trialled it in junior school… with cross-curricular assignments, and maybe it was design, didn't work so well." (T5) • "So long as it's communicating and showing- demonstrating understanding of those core science concepts, those big ideas, yeah." (T10) • "does the actual making the task… is that so complicated that it subtracts from the kids being able to complete the physics part of it" (T12)
Storytelling for assessment (n=8)	Eight interviewees (T2, T3, T4, T6, T7, T8, T9, T11) were interested in using storytelling for students to show understanding of science in NCEA assessments: • "definitely a lot of potential for that to work. Especially for nervous kids that don't want to say it themselves…that one step removal. You know, my character's saying this, not me." (T7) • "Yeah, that sounds great." (T11) Five teachers (T5, T9, T10, T12, T13) raised concerns they have with use of storytelling: • "it depends on whether I'd be teaching… how to do the storytelling versus just assessing it." (T5) • "my low-level students they get lost. They get lost in the story and they don't know what's relevant and what's not and how to go from there" (T9) • "it depends what we're trying to assess…if we had standards that were written in such a way that we could use science communication as a tool to convey an idea or a concept. I think it could be done, but I think it would have to be the detail in the standard that would allow for it" (T10) • "yes, but I would like to see an example of how that worked." (T12) • "the one challenge with things like that is, is students get more invested… in the details of the character, or…the sort of the production quality of the filming, rather than the sort of scientific content thereof as well." (T13) Three (T1, T5, T13) teachers sought clarification on what constituted a story and from these, the view of one was unclear: • "I didn't know that was a story, I think that's what we already do." (T1)

Theme 4: Barriers to creative assessment methods

Barriers to using creative cross-curricular assessment for NCEA science were varied and many. Most frequently noted were issues arising from working with other people, both with co-ordination of time to work together and circumnavigating differences in opinion. Teacher and student time and workload also posed significant barriers and these issues were often intertwined. NCEA itself, both due to its current restrictive nature and the uncertainty posed by the upcoming overhaul of the

system was also a major contributing factor to teacher unwillingness to try innovative assessment practices.

Table 17. Barriers to using creative assessments for NCEA science.

People (n=10)	Ten interviewees (T1, T3, T6, T7, T8, T9, T10, T11, T12, T13) expressed issues with other teachers: • "you can change yourself but… it becomes a lot more challenging to change in others." (T3) • "Not everyone's got other teachers at their school that care or that are interested." (T6) • "You've got to have a really good bond with that teacher and know their strengths and weaknesses." (T7) • "Probably just people. We're limited by our own… creative ideas or, we get stuck. I have seen where people just get really stuck on only assessing in a certain way and they just can't get past that." (T10) • "to get everyone on board, 'cause a lot of people are very traditional in the way they like to teach. So, making those people swing over to… a different style of assessing can be really challenging." (T11) Two teachers (T1, T7) commented on the barriers caused by parents: • "You get a few parents who are like, 'What? Just write an essay.'" (T7) One teacher (T7, with previous experience of creative cross-curricular assessment) described barriers presented by students: • "my biggest problem is I'll say, 'Do whatever you want.' And they all do essays." (T7)
Time (n=8)	Of the eight teachers who included time as a barrier, seven (T2, T3, T4, T5, T6, T8, T9) described issues with time to prepare resources and/or upskill: • "Just setting it up…putting in the groundwork to get it going" (T2) • "some of it would be time in terms of… getting time to get your head around some of these new things 'cause there's thousands of things you can try and so many hours in the day." (T3) • "people don't necessarily have time to go, 'Hey what are you doing in your subject that will link in with this?'" (T4) • "it's always just finding the time to do all the PD as well, I guess." (T5) Two (T9, T11) mentioned time constraints associated with the tasks themselves: • "for the students the time to do the work and for us time to assess, 'cause it's… much harder to assess obviously than just the written test where it's like, tick, don't tick." (T9) • "the length of time to mark them… a test can be quite quick to mark, whereas if you've got a different type of assessment it can take a long time to mark" (T11)
Workload (n=6)	Six teachers (T2, T4, T6, T8, T9, T12) mentioned issues of workload, all of which included teacher work and one (T9) considering demands on students: • "There's just so much to do with assessments already" (T4) • "I think a lot of teachers are just swamped by workload." (T6) • "There's a lot of work that goes into making sure that these assessments are actually meeting the standard. Going and working through all the different aspects of it." (T8) • "it's a huge load on these teachers, some of these teachers, to try and change what they're doing." (T12) • Of students: "is their…cognitive load full from trying to make the animation as opposed to describe the science" (T12)

NCEA Restrictions (n=6)	Six teachers noted NCEA restrictions as barriers to use of creative cross-curricular assessment. Within this group, four teachers (T3, T8, T11, T13) described problems caused by the nature of NCEA standards: • "Some of it is NCEA itself… Some of the prescriptive nature of the assessments." (T3) • "it's been quite a struggle to find ways that it can, can connect to each other." (T8) • "I can't work out how to do it with current standards of NZQA." (T11) • "ultimately in New Zealand I think we have an open curriculum, but we actually have closed assessment." (T13) Two teachers (T7, T8) noted the impending changes to NCEA as barriers: • "trying to get buy-in from other staff to do those cross-curricular, novel project kind of style things. Especially when NCEA is about to change." (T7) • "Particularly with the looming changes, no one's really keen to start anything new." (T7) Three teachers (T5, T6, T8) also mentioned issues with administration of tasks: • "keeping the assessments – how would they be stored? And, I guess marking them… And also trying to find somebody to… check mark your work is going to be tricky. Because they're not going to understand as easy, what's going on." (T5) • "trying to think of authentic contexts…something that's actually going to get the… right depth of knowledge level for… Level 1, 2, or 3 whatever you're trying to work towards." (T6) • "I think one of the scariest things for most of the teachers is about the moderation conditions that come with being more creative about an assessment." (T8)
Fear/risk (n=5)	Five teachers (T3, T6, T8, T12, T13) named or implied fear or risk as a barrier to creative assessment: • "particularly with assessments, um, there's almost a fear. Like, 'If I get it wrong, none of my kids pass.'" (T3) • "Then you have to create a rubric for each one, find a way it can be measured against it… there's a lot of fear about that." (T8) • "to be brave enough to trial it and receive feedback from kids and other teachers" (T12) • "a lot of schools um, basically out of fear of, of the moderator's response essentially use tasks that have been written by the ministry." (T13)
Techer Knowledge (n=4)	Teacher knowledge of NCEA standards and creative assessment practices arose in four conversations (T3, T4, T8, T9): • "Not just the time to do it but the time to understand it at a depth that makes it meaningful." (T3) • "I guess just the lack of examples and the lack of knowledge out there about it." (T4) • "it's also just experience, being able to see it, have a look at how it's worked" (T8) • "I don't know what the students are studying in History, Geography, English. Now how do I choose a task that's going to match what they are doing and… credit across both and all these things" (T9)
School (n=2)	Two teachers (T5, T9) mentioned school issues: • "Another issue I just thought about now is the timetable" (T9) • "departmental requirements… school requirements… And of course, the costs, too, to the school." (T5)

Theme 5: Professional development needs

Teachers interviewed were positive when offered the option of professional development (PD) for creative assessment methods in NCEA science. There were a range of preferences for type and delivery, but consensus was reached on the need for resourcing and examples, and interaction with other teachers. Teachers were divided on whether PD should take place in person or online and this was largely dependent on their location: teachers in remote places were more often positive about online courses. Many teachers expressed the need for ongoing support, either in the form of a long-term course or follow-up support from schools or PD administrators.

Table 18. Teacher professional development preferences.

		Number of responses
Type	**Collaboration:** all teachers noted the need for collaboration with other teachers for PD. • "I like having the opportunity to bounce ideas off people and have other people expand and guide my ideas" (T4) • "many hands make light work and putting your heads together to write custom tasks… if you've got two or three teachers that are firing in ideas, then it's always easier, right?" (T6)	13
	Resources: teachers wanted resources for assessment tasks to be provided for them or to have the opportunity to make resources themselves. (T2, T3, T5 T6, T7, T8, T9, T10, T11, T12, T13) • "I need to see an example, work through it, have a go at marking it, and then maybe think about how I could go the next step." (T5) • "sharing resources, stuff that you can adapt to your own school" (T6) • "if we're going to make it more authentic then the teachers need to be involved in creating those assessments and tailoring them to their students" (T7) • "if there was already a unit, or a standard, and it's already prepared so literally a teacher can… pick something up and run with it." (T10)	11
	Previous experience: help from people with previous experience of using creative assessment tasks (T3, T6, T9, T10, T11, T13) • "Examples of what actual teachers had done and, and how had it worked, or had it worked or not worked" (T3) • "if there were people who were willing to come into a school and to help set that up and run it for the first time. Because, often it's just overcoming that stress or anxiety about running a new assessment when there are unknowns." (T10) • "the ideal would probably be something like a workshop where you talk to people, someone who's done this and they talk about what the pitfalls were and you know, what worked well and things like that." (T13)	6
	Research: research-based reasoning included in PD opportunities. (T1, T3) • "I want someone to arrive with research and tell me what they have looked at, I want them to do the hard work, I want them to go away and bring all of this research together into an integrated package that puts out questions for discussion" (T1)	2

	• "A little bit on the research about why we're trying all of this." (T3) **Other:** suggestions made only by one teacher for other forms of PD: • "Student voice…did the kids engage with it and… not just did they pass but did that lead to any sort of deeper analysis or deeper understanding, or deeper enjoyment of the subject?" (T3) • "going around the different subject areas and becoming more aware of what different people are doing would be helpful." (T4) • "like a fortnightly Zoom slot, or… using the GoogleDrive, using Dave Thrasher's drive a bit more, 'cause there is not a lot in there… A folder for cross-curricular ideas" (T6)	3
Delivery	**Workshop:** One-off PD opportunity completed in person (T1, T3, T5, T8, T11, T13) • "workshop to start off with. Just to brainstorm it and get you know, kind of see how it works." (T11) • "I'm a big fan of teachers being able to leave school and go to other places to learn. I think that that's a really important aspect of it. So, like, a workshop with resources would be in particular." (T8)	6
	Course: Ongoing PD with opportunities to work on resources and assessments between sessions, online or in person (T2, T4, T7, T9, T12) • "a short course. So, like short and frequent… Like, you know, go away, create something, bring it back, discuss it, what's the next step?" (T2) • "I think possibly a string of PD, so over a couple of years would work better" (T9)	5
	Follow-up: Need for long-term support either within school or in PD group (T2, T4, T5, T6, T7, T8, T9, T12) • "I think regularly definitely helps because you can see the whole process through, in that you can get ideas and then you can go away and build the ideas and see how it plays out for you, and then come back and evaluate as a group as well and see what, what happened and what you could have done differently" (T4) • "It doesn't necessarily have to be administered by an outside body, but there does have to be some sort of… consistent meet-up." (T8)	8
	Online: some teachers expressed preference for online delivery (T2, T4, T6, T7)	4
	Some teachers expressed aversion to online delivery (T1, T5, T10, T13).	4

3.4 Interviews Discussion

To complement the data generated from the online questionnaire, interviews with individual teachers were conducted. The aim of this part of the research was to provide deeper understanding of the opinions of teachers towards creative assessment, and to answer the research question: **what types of professional development can help teachers to overcome barriers to combining science and arts achievement standards in a single project?** The issues and possible solutions to these were able to be explored in more depth than in the questionnaire to give a more comprehensive picture.

As with the results from the questionnaire, this analysis cannot be generalised to the whole secondary science teaching population of New Zealand. However, there is still much value in the

findings as the issues raised in the interviews will be familiar to most teachers and the suggestions for solutions will be relatable to many schools (Bell & Waters, 2014). These interviews provided a range of issues and attitudes encountered by the secondary science teaching community of New Zealand, which is precisely what the study aimed to discover. Best efforts were made to keep bias at bay when selecting and interpreting excerpts from conversations. However, bias is an insidious beast and undoubtedly has managed to sneak in undetected, especially as conversations were transcribed and only audio was used for analysis (Cohen et al., 2011). Quotes were kept as far as possible exact, with omission of pauses and filler words for ease of reading in the report. As with the questionnaire, "teachers" refers to respondents, unless otherwise stated.

Research question one: What do teachers think about cross-curricular assessment of science and arts in NCEA?

Overall, teachers interviewed for this study were open to the idea of cross-curricular assessment for NCEA science, but some teachers had reservations. Teachers who had previous experience of cross-curricular assessment were more likely to be positive about it than those who did not: of the six teachers whose responses showed they were very interested in this, four had previous experience. All three teachers who expressed reservations about creative assessment had not previously tried it. Due to the small sample size of 13 interviewees, it is not possible to say that *all teachers* are positive about creative cross-curricular assessment. However, it can be asserted with confidence that *there are* teachers who are positive about these assessment methods. This validates the pursuit of a creative project to provide teachers with resourcing for such activities in their classrooms.

When it comes to use of storytelling for assessment, there is promise. As this is not common practice, there was uncertainty amongst interviewees as to what exactly storytelling entails. Although teachers had the opportunity in the interviews to seek clarification and this was done on three occasions, it is plausible that teachers had different views of this concept (Cohen et al., 2011). Eight of the teachers interviewed expressed interest in using storytelling as an assessment strategy. Of these, only two had tried using storytelling before, and only three had previous experience using cross-curricular assessment. Again, it can be concluded that there are teachers who are genuinely interested its use, and that is sufficient to justify creating resourcing for storytelling as an assessment method.

Research question two: What are the barriers to assessing more than one standard with a single project?

This question drew candid responses from interviewees. It was reported that the biggest barrier to successfully implementing creative assessment methods for NCEA science was people. There was little difference in this perception between teachers who had used cross-curricular assessment previously (four out of five) and those who had not (six out of eight), echoing the findings of the

questionnaire. For the most part, this supports the literature discussed in the review that highlighted issues of timetabling, teacher confidence and/or knowledge, and loss of subject integrity as major barriers (Arrowsmith & Wood, 2015; Dowden, 2012; Edwards, 2013; Osbourne, 2014; Rata & Taylor, 2015). However, teachers interviewed commonly reported issues with other people, and none of them discussed insecurity with losing their subject identity. This may be because respondents were self-selected based on their interest in this research and so were likely to be open to sharing subject content. Social desirability cannot be ignored here either: no one likes to come across as a grumpy old teacher when talking to a stranger (Check & Schutt, 2012). However, there was a certain amount of reported helplessness (or at the very least difficulty) when it came to getting other teachers on board with innovation. This ties in with the issues of time and workload, which also made frequent appearances in conversation. These two are difficult to separate as ultimately one leads to the other: an unmanageably large workload chews up a lot of time, and lack of time decreases capacity for extra work. It is easy to stick with the status quo when time is short. This can then impact the level of co-operation from other teachers: if they too are struggling to keep up with the demands on their time, finding opportunity and inclination to work with someone else is challenging.

Issues regarding limitations posed by NCEA arose on many occasions and although steps are being taken to improve the system, so far this had created more angst than peace amongst teachers. Limitations of subject-specific requirements and intricacies of administering, marking and moderating tasks were the biggest contributors to lack of interest in creative assessment. It is significant to note here that perceived issues with alignment of standards were only mentioned by teachers in the NPE group, suggesting that the thought of combining standards is a bigger barrier than the reality.

It is important to mention the sense of fear and responsibility some teachers mentioned when considering innovation for assessment. It is not lost on them how heavy the weight of assessment and earning credits is for students. Of the five teachers who mentioned this issue, two were in the PE group, suggesting that even with experience of cross-curricular assessment, there is still apprehension. There is often a lot at stake and ultimately, the buck stops with the teacher. If they try something and students do not achieve as expected: “at a certain point I’d have some questions to answer” (T3, NPE). It is a sad reality that many teachers do feel responsible for the success of their students and innovation in assessment is too scary to risk (Arrowsmith & Wood, 2015; Edwards, 2013; Rata & Taylor, 2015).

Research question three: What do teachers need to overcome barriers to be able to use cross-curricular assessment for science and arts in NCEA?

The interviews highlighted that teachers were crying out for the hardest thing to manage in teaching: collaboration. Every single teacher interviewed described the need to work with others on some level. Form bouncing ideas around a room or online chat; to making resources together; to hands-on help in the classroom, teachers wanted (and needed) other teachers to work with. Of particular value were those brave souls who have developed assessment tasks and tried them out in the furnace of classrooms doing NCEA internal assessments. Six teachers mentioned this as a preference for PD and of these only one was in the PE group. This relates to the barrier posed by the view that innovation is high-risk. If someone has tried the assessment already and can share their experience and resources, the fear can be somewhat alleviated. This also supports the research conducted by Hipkins, (2014) reporting that teachers are more likely to implement change in their classroom practices if they have a clear example to work from.

This brings us to the need for assessment resources, highlighted by 11 of the teachers interviewed. Whether they are provided pre-made and moderated, or the opportunity is given for teachers to make their own, work on them, and then discuss successes and challenges, assessment cannot happen without a task. Of the 11 teachers who requested this, only one did not mention the need for an example and only two did not state that they would like to use the example to then develop their own assessment tasks. The fact that only one teacher interviewed was confident that devising and delivering assessment tasks was the easy part indicates that teachers need support with creative assessment. This aspect of the interviews provided insight that the questionnaire could not: the option for assessment resources for PD was not given on the questionnaire.

It is appropriate to note here that the demanding nature of teaching was highlighted in trying to schedule times to talk with teachers. Four other teachers volunteered to participate in this study, but due to reasons out of their control (usually work-related) they could not manage to meet or in some cases even book a scheduled appointment. On more than one occasion I was left sitting in front of an image of myself on my computer screen, waiting for an interview that was never to eventuate. It speaks volumes of the demands on teacher time and mental capacity, that several of them when reminded of their commitment after at least a week had not had time to even look at the interview material, let alone organise a time to talk. Any PD that can lessen the requirement of teacher time and mental energy is valuable.

So, in answer to the initial question: professional development that allows teachers the chance to work with others, balanced with time to work and experiment with their own classes and ongoing

support was the most popular. Workshop-based PD was agreed to be a useful start, but as pointed out by Arrowsmith and Wood, (2015) long-term individualised support is needed for lasting change. Several teachers mentioned this need in conversation.

3.5 Research Conclusions

The data gathered from both the online questionnaire and semi-structured interviews combine to give a picture of the opinions and needs of secondary science teachers in New Zealand relating to creative cross-curricular assessment in NCEA. Together these methods can help answer the question:

What types of professional development can help teachers overcome barriers to combining NCEA science and arts achievement standards in a single project?

Professional development is not the solution to every problem encountered by teachers of NCEA science wanting to use creative assessment methods, but it can lessen the major barriers significantly. A programme providing resources and examples can reduce the time teachers would need to invest in generating assessment tasks. This would in turn reduce teacher workload as the task is ready-made for them. Provision of proven assessment resources may also help to alleviate the fear of trying something new and having it fail, expressed by some teachers. This could then lead to conversion of other teachers to a new way of assessing. If it can be modelled that creative assessment is more attractive to conduct and mark, and that NZQA moderation will be a positive experience, teachers may be more willing to give it a try.

Responses from both the questionnaire and the interviews indicate that many of the barriers were out of teachers' control, involving school administration issues and difficulty co-ordinating teachers and departments. Although a programme of PD cannot change the school timetable or make it easier for teachers from different departments to meet together, it can lessen the effects of many other barriers.

Teachers who have used creative cross-curricular assessment methods previously are enormously valuable to the teaching community. Their positive attitude towards trying novel assessment methods and expertise in designing units of work and assessment tasks are crucial to the uptake of creative cross-curricular assessment methods by teachers with no previous experience. It could be that the biggest barrier for teachers to overcome is trying creative assessment in the first place. Once teachers have experience of using creative assessment methods with their classes, they are more likely to want to repeat the process and possibly less likely to revert to traditional methods. There is some evidence to suggest that teachers who are early in their career may be more open to

trying innovative assessment methods than those who have more experience. Professional development resourcing could then be targeted at this group for maximum effect.

From the information provided through analysis of questionnaire and interview data, the creative project of this thesis was born. Two workshops were run with teachers in my school who were interested in using podcasting as an assessment method to upskill them in the practicalities and classroom management strategies involved. In addition to this, a website was created, providing resources for teachers on how to use storytelling for science assessment, practicalities of producing creative assessments, and examples of creative assessment tasks for teachers to use. The need for collaboration was addressed by the nature of the podcasting workshops carried out with a small group of teachers working together and the provision of an opportunity to ask questions and connect with other teachers with interest and/or expertise via the website.

Part Two: Creative Component

Chapter 4: Podcasting Workshops

In Term 1 of 2020, I ran a professional development session with eight of my colleagues at Otago Boys' High School (OBHS) in Dunedin to show them how to use podcasting as an assessment method with their classes. Participants chose to attend a 45-minute session before school, during allotted professional development time. The participants came from a variety of subject areas and displayed a range of experience and confidence with using technology for classwork.

In line with the recommendations of Arrowsmith and Wood, (2015) this professional development was designed to cater to the individual needs of participants and came with the offer of ongoing support. This was carefully planned to be a practical session, that participants could leave with a project to work on in their own time (as suggested by at five of the interviewees from my research, one of whom happened to attend the workshop). Also considered was the view of T13, "the ideal would probably be something like a workshop where you talk to people, someone who's done this and they talk about what the pitfalls were and you know, what worked well and things like that." As discussed by Timperley et al., (2007) there are three main processes involved in teacher professional learning: "cueing and retrieving prior knowledge, becoming aware of new information and skills, and creating dissonance with a teacher's current position" (p. 7). The podcasting workshop mostly addressed the first two of these. For most participants, there was a small amount of prior knowledge to draw on, which helped them to engage with the content, and allowed them to share with each other (as some had used podcasting with their classes already). Most of the content covered was new to participants, but still fit within their beliefs of teaching and learning, in line with the second process of teacher learning. This means that teachers were challenged to increase their skill level without the pain of changing their values about teaching (Timperley et al., 2007). In the first session, teachers learned how to make a voice-recording on their phone, how to get the audio file from their phone to their computer and into the editing software (Audacity), and how to use basic editing techniques to add music and sound effects. This alone may have been enough for many teachers to gain the confidence required to use innovative practices in their classrooms. As stated by Timperley et al. (2007), "One-off opportunities may be adequate if the learning involves relatively straightforward transmission of information or increased awareness of new ideas" (p. 10).

Such was the success of this session that many participants requested a second session three weeks later in the same professional development time slot. This aligns with the finding by Timperley et al. (2007) that, "deeper learning typically requires repeated cycles of engagement with learning processes, practice, and outcomes" (p. 8). This time, they were asked to pre-record a favourite story

or poem before the session began so that they could work on editing it during the workshop. This again addressed the suggestion by five of the teachers interviewed to take something away from a session to work on in their own time. In this session, every participant learned how to cut and move audio and add their choice of music and sound effects to create the desired tone of their podcast. Most encouragingly, many of them discussed the possibilities of combining standards from their different subject areas for assessment purposes (without my prompting).

The plan with this was to have each participant create their own podcast and share it with the group following the session. Unfortunately, we were rudely interrupted by a global pandemic and this step never came to fruition. However, I was informed through positive reports to senior management and email correspondence that participants were satisfied with the outcomes of the workshops, and some went on to use podcasting with their classes:

- "Your PD was very helpful. It was good to actually try doing some practical work with audacity. It meant that I felt knowledgeable enough that I could give my boys some basic instructions on how to use the programme."
- "I found it very useful."
- "I thought it was really cool and fun! I learned a lot and found that going over it a couple of times helped build my confidence with it. Annoyingly, the lockdown meant the topic (1080) that I usually podcast ended up just being a report. But, I will use it next year!"

Since the podcasting workshops, one of the attendees has been running a podcasting assessment with her English class. She has taken me up on my offer for ongoing support by agreeing to arrange a time for me to visit her class to give extra support to the students when they come to edit their podcasts. This is in line with the suggestion of T10 in their interview that having an experienced teacher visit their class to help run the assessment would be beneficial.

Chapter 5: Website Laborastories.nz

The major component of this creative project was the website Laborastories.nz, http://laborastories.nz/, created as a resource bank and source of advice for teachers interested in using storytelling and/or creative assessments with their NCEA science classes. Each section of the website addresses the needs expressed by teachers both through the questionnaires and interviews conducted in my research. The website also addresses the major disadvantage of one-off teacher professional learning as noted by Timperley et al. (2007) that there is not enough time given for teachers to engage fully with the suggested changes in practice. By providing resources that can be accessed by teachers as and when needed, Laborastories.nz caters for the need for ongoing engagement and support of new teaching practices (Arrowsmith & Wood, 2015; Timperley et al., 2007).

The design of the website was carefully planned following the advice of Lawrence & Tavakol, (2007) to keep it as simple as possible and to maximise usability. To do this, I loosely followed the layout of the website, Science Learning Hub https://www.sciencelearn.org.nz/ (University of Waikato, n.d.), as this is a well-established and respected website providing resources and professional development for teachers of science. Advice and assistance from a professional web developer, Alan Jordan, was also enlisted to ensure the technicalities of the website were in order and it looked and functioned as desired.

The website is laid out to follow three levels of confidence with using creative methods for NCEA science assessment (beginner, intermediate and advanced), divided into three questions visitors to the site might ask: *Where do I start? How can I take this a step further? How do I turn this into an assessment?* Each question links to a different section of the website providing resourcing and advice for teachers to use in their classrooms. The home page includes the promotional animation used at the beginning of my research journey to explain the goals and purpose of the website.

The website was shared with the all the participants of the research, including heads of subject associations who helped with distribution of the questionnaire, interviewees, Facebook teaching groups and NZASE, as well as teaching colleagues who participated in the podcasting workshop. Feedback was positive from those who visited the site, and the following was a representative response: “Thank you so much Mary. Love this as a way to also engage our cultures that learn through storytelling – so powerful! Well done.”

The sections of Laborastories.nz are as follows:

The Research

The purpose of this page is to address the issue raised by T1 and T3 in their interviews that they would like evidence-based reasoning for using storytelling for assessment with their classes. It gives a concise summary of the literature supporting the use of stories in science teaching and learning. It also gives credibility to the website and to me as the author. It is important that teacher education provides resourcing that is appropriate to the audience and is delivered by someone with sufficient expertise: "the role of a provider of professional learning opportunities is to assist teachers to reach higher levels of expertise" (Timperley et al., 2007, p. 11). As noted by Orland-barak and Hasin, (2010) key attributes of a teacher educator include, "integration of theory and practice, knowledge and expertise" (p. 431). By including this section, visitors may be more likely to follow the advice given and to use creative assessment methods.

Activities

This page is designed for the novice users of storytelling in science and is divided into three sections:

- **Writing Activities:** this links to a list of short activities that teachers can use in their classes to get themselves and their learners acquainted with creative writing in science. It includes original printable resources for teachers to use and tips for how to include each activity in a lesson. This is the absolute beginner-level.
- **Writing Templates:** this is a link to two original templates used by me for assessments and an external website that provides free printable planning templates I have also used for assessments. This is for the slightly more experienced.
- **Useful Links:** this is a page of links to external websites that have useful resources for using stories and creative assessment methods in science. This is for the more experienced teacher (and students).

This page addresses both the need for a place to start as highlighted in both the questionnaire and interview process. In addition, it also covers the need for resources, examples, and the expertise of someone who has used these methods in class. The tips provided for each activity aim to alleviate the anxiety of trying something new with a class by providing guidance on how to run the activity in a lesson. This section is aimed at both experienced teachers who are perhaps resistant to changing their practices and new teachers who are lacking experience in the classroom, by providing small activities that are easily incorporated into lessons with low risk of adverse experiences.

Podcasting

This page is for the intermediate-level teacher, who is ready to try creative assessment with their classes. It is based on the podcasting workshops run as the first part of this creative project, and the level of guidance was targeted at the least capable of the attendees at the workshop (who also happened to be the most enthusiastic). Included in this section is a more detailed printable version of the guide to podcasting, designed for teachers to either use themselves or share with their students. The rationale for the level of detail in the instructions comes from personal experience of both making my own and teaching students to make a podcast — teachers cannot help every student at once, so the instructions are designed to be used without teacher assistance. This section has received positive feedback from a teacher who has made use of the printable version: "It is way better than what I gave them. No pictures in mine." It has also received positive feedback from one of the students who used it for his assessment, saying it was very helpful for him.

Assessments

This page links to two unit plans with resources and advice on how to use storytelling and/or podcasting for assessment in NCEA science: Stories – Death of the Dinosaurs, and Podcasting – The Physics of Music. Each assessment page includes a generic copy of the task for teachers to adapt for their classes, a week-by-week unit plan, printable resources for use as templates and sources of information, and tips for how to structure lessons and avoid pitfalls during the assessment.

This page caters for the needs expressed by most of the interviewees for using creative assessment methods: tasks, resourcing, and expertise from someone who had already used them with classes. For example, T10 indicated they would be more likely to try creative assessment methods, "if there was already a unit, or a standard, and it's already prepared so literally a teacher can… pick something up and run with it." It also supports the research presented by Hipkins (2014) that "change will seem more compelling when teachers have access to clear examples of how the intended learning action might look" (p. 47). A possible limitation of ready-made resources is that there is not a one-size-fits-all solution to assessment tasks. Assessment needs to fit the context of the school and the learners who are participating in the process (Ministry of Education, 2006). Using a resource designed for specific learners in a particular part of New Zealand may not lead to authentic outcomes for learners. However, the tasks provided on Laborastories.nz are generic so that teachers can alter them to suit their learners.

There has also been a positive response to this section: "Some really great ideas and I like that you've shown how you've broken down the tasks and given some good management pointers. That's really useful, thanks." (Comment from a member of the NZPT Facebook group).

One of my colleagues, a teacher at OBHS, is currently using storytelling through boardgames as an assessment method with one of her classes. She has been able to try some of the strategies suggested on Laborastories.nz and has made the most of my availability to answer questions and collaborate with her on refining the task and tailoring the presentation to suit her learners. For some, paring down the idea of a fully developed story to a basic narrative structure with a beginning, middle and end will be more achievable as a first attempt with creative presentation.

Contact/Comments

This section was included on every page of the website to address the main need expressed by teachers in my research: collaboration. It gives the opportunity for visitors to the site to ask questions of me and to share their resources on the website. As pointed out by Shank, (2005) teachers are able to teach each other when they have a shared goal, positive relationships and a culture of collegiality and support. This section aims to encourage this. It also addresses the need for help from someone with previous experience of creative assessment. As I have used creative methods and storytelling with my classes, I am able to provide this support and reassurance that the rewards are worth the initial investment of time and effort.

About Me

This section was included to address one of the most important aspects of teaching: relationships (Chu, 2018). Although naturally introverted and quite happy to remain anonymous, I am well aware of the need to be open with those you are teaching. It was important to include this section so that visitors to the site could get an impression of me as well as my passion and expertise. As noted by Chu, (2018) for a mentor teacher to be able to effectively teach their mentee, there needs to be a sense of relationship. By understanding me and where I come from, visitors to the site may be more likely to use the resources provided.

This website is not intended to be a finished product, but a living and evolving collection of useful resources and strategies. The aim of Laborastories.nz is to provide teachers with a place to find resources and ideas to use with their classes as well as a way to connect with other teachers who aim to do the same. I envisage that the amount of content will continue to grow as I and other teachers continue to push the boat out with our classes and share our experiences with others.

Chapter 6: Concluding Statements

Recent events have caused a world-wide rethink of how education is done. As I write this, New Zealand is at Alert Level 3 of its global pandemic plan. We have just completed almost five weeks at Level 4, the highest level, in which only services deemed to be essential were able to continue as "normal". Around the globe teachers have had to adapt to teaching their students online. There have been a lot of old dogs learning new tricks.

Perhaps this is not a bad thing for our learners. Being forced out of our comfort zones of well-practised strategies and lesson plans—although not great for our sense of place in education or our mental well-being (Osbourne, 2014)—may eventually help us to be better teachers. This abrupt upheaval of the familiar has meant that teachers have been forced to try new practices. For many, this would have been an adaptive change, challenging their beliefs and tested methods (Osbourne, 2014). Maybe, those previously unwilling to shift their pedagogical ideals will be more open to trying other approaches now that the initial shock to the system is over. Rethinking assessment methods may now be less of a jump and sit closer to one of Osbourne's (2014) technical changes, in which teachers can draw on their experience to adjust their practices. Also, by placing individual students at the centre of every activity and giving them the freedom to get on with the job in their own space and time, they may just be enabled to become better learners and communicators. The subject boxes do not exist when you are learning from your kitchen table, and perhaps they should not exist at school either. Compartmentalising learning into separate disciplines such as Physics, English, and Mathematics is not a reflection of the real world and it does not fit with the world view of many of our learners. By integrating skills from across the curriculum, we give our learners a better chance of success and may empower them to learn in ways that value their cultural identity (Tolbert, 2015).

The proposed changes to NCEA align far better with the NZC than the previous system, by encouraging integration of skills from across the curriculum. The proposal to have fewer, larger achievement standards makes it difficult to combine standards across subjects as suggested in this thesis (what teacher in their right mind would let someone from another subject area take one of their only assessment tasks and rehash it for themselves?). However, the nature of the draft assessment tasks is such that integration of skills will still be necessary for successful completion. Although there may not be the reward of credits from two subjects for one piece of work, there may instead be the reward of a higher grade in a single subject by being allowed (and encouraged) to express oneself in ways that best suit one's interests, strengths and values.

Teachers cannot shift the habits of a lifetime on their own, and nor are they expected to. The Ministry of Education has promised eight teacher-only days to help with implementation of new programmes of work to include the new standards. This is great in theory but will only work if teachers get what they need: time to work together to develop assessment tasks as well as their own skills at assessing them. As Hipkins and Spiller (2012) so aptly put it, "removing barriers does not necessarily equate to stimulating and supporting change." (p.6). Teachers with experience of creative assessment are vital to this process, which is why Laborastories.nz is such a valuable resource. Removing some of the barriers to trying creative assessment is at the very least a start to gaining widespread change in pedagogy and assessment of NCEA science. Once teachers experience for themselves the many benefits of storytelling and creative assessment—greater engagement from learners, more enjoyable lessons to teach and participate in, learners having a sense of being able to achieve in assessments, less strenuous and repetitive marking (all of these I have experienced myself)—they may be less likely to want to go back to their previous methods. If these teachers are then given the opportunity to show the way and help remove the fear of the unknown for others, change in NCEA assessment practices across the country is possible. Future research could examine the benefits of creative assessment in other subjects such as English, Digital Technology, and Media Studies for teacher enjoyment, learner engagement, and assessment outcomes. Let's not forget, the reason for creating Laborastories.nz is so that our learners can engage with science and become, "confident and creative, connected and actively involved." (Ministry of Education, 2006, p. 4).

Appendix A: Survey Instrument

Storytelling for NCEA Science Assessment

Thank you for taking the time to fill in this questionnaire. It should take you approximately 5-10 minutes to complete. In this particular survey, we would like to determine how interested science teachers are in assessing science knowledge through creative assessments that focus on storytelling such as podcasts, videos, animations, and song lyrics. There is the potential that this creative approach could lead to cross-curricular assessments that allow learners to earn NCEA credits in a way that reflects their strengths and interests. I will use the information from this survey to inform my study for my Masters project. This project aims to provide resources that facilitate creative cross-curricular assessment of science standards. Please read the attached background information page before giving your consent to participate in this survey.
Participant Information.pdf
I have read the attached information and give consent to participate in this study.
- Yes
- No

Section 1: Background information

(Information to be used for statistical purposes only)
What region is your school in?
- Northland
- Auckland
- Waikato
- Bay of Plenty
- Gisborne
- Hawke's Bay
- Taranaki
- Manawatu-Wanganui
- Wellington
- Marlborough
- Tasman
- Nelson
- West Coast
- Canterbury
- Otago
- Southland

What is your school type?
- Secondary (Years 7-15 or 9-15)
- Composite (Years 1-15)
- Special School
- Teen Parent Unit
- Kura Kaupapa
- Other (please specify)

What is your school decile band?
- 1-2

- 3-4
- 5-6
- 7-8
- 9-10
- Private
- Don't know

How many years have you been teaching? (Including this year)
- 1-9
- 10-19
- 20-29
- More than 29
- Prefer not to say

What is your specialist subject area? (Select all that apply)
- Agriculture
- Biology
- Chemistry
- Earth and Space Science
- Horticulture
- Physics
- Science
- Other (please specify)

Do you currently use NCEA Achievement Standards for assessment?
- Yes
- No
- Don't know

What is your ethnicity? (Select all that apply)
- NZ European/Pākehā
- Māori
- Asian
- Pasifika
- Other ethnicity
- Prefer not to say

What is your gender?
- Male
- Female
- Gender diverse
- Prefer not to say

What is your age bracket?
- 20-29
- 30-39
- 40-49
- 50-59

- 60+
- Prefer not to say

Section 2: What do teachers think about cross-curricular assessment?
Cross-curricular assessment is using achievement standards from more than one subject area to assess learning in a single project/assignment.

Have you used cross-curricular assessment for NCEA Achievement Standards in a science-based course?

- Yes
- No
- Don't know

To what extent do you agree or disagree with the following?

	Strongly Disagree 1	2	Neither agree nor disagree 3	4	Strongly Agree 5	Don't know
I am willing to try a variety of ways of assessing NCEA Achievement Standards in science courses						
I am interested in using cross-curricular assessment tasks in NCEA science courses						
I am interested in using storytelling as a way for students to show understanding of science concepts for cross-curricular assessment tasks						
I am confident using cross-curricular assessment tasks in NCEA science courses						
I am likely to use cross-curricular assessment for NCEA Achievement Standards in a science course in future						

To what extent do you agree or disagree with the following?

I think combining Science and Arts (e.g. English, Media Studies, Drama, Music, Art) Achievement Standards for assessment of science understanding:

	Strongly disagree 1	2	Neither agree nor disagree	4	Strongly agree 5	Don't know

Can improve learning for students						
Can increase student engagement						
Can improve student achievement						
Reflects the real world better than single standards						
Decreases student workload						
Prepares students for future learning						
Is more enjoyable for teachers						

Are there any other thoughts you have about using cross-curricular assessment not listed above? Please list them here: (Optional)

Section 3: What are the barriers to using cross-curricular assessment?

To what extent do you agree or disagree with the following?
I think combining Science and Arts (e.g. English, Media Studies, Drama, Music, Art) Achievement Standards for assessment of science understanding:

	Strongly Disagree 1	2	Neither agree nor disagree 3	4	Strongly agree 5	Don't know
Is too hard to co-ordinate with other teachers						
Is beyond my level of expertise						
Is too demanding on teacher workload						
Takes too much time to prepare						
Is too hard to assess						
Is not supported by other teachers in my school						
Is not supported by senior management in my school						
Is not supported by students in my school						
Takes away from learning subject-specific content						

Are there any other barriers to using cross-curricular assessment of science Achievement Standards that are not listed above? Please list them here: (*Optional*)

Section 4: Professional Learning Opportunities

To what extent do you agree or disagree with the following?

	Strongly Disagree 1	2	Neither agree nor disagree 3	4	Strongly agree 5	Don't know
I am interested in learning how to use technology (e.g. podcasting, animation,						

video) for assessment in NCEA science courses (4)						
I am interested in using cross-curricular assessment in NCEA science courses (5)						
I am interested in learning how to use storytelling for assessment in NCEA science courses (3)						
I would use cross-curricular assessment in NCEA science courses if professional development was provided (1)						
I would use storytelling for assessment in NCEA science courses if professional development was provided. (6)						

Please select your preferred choice(s) of professional development delivery from the list below:

- 1-day workshop
- Short course (3x 2-hour sessions)
- Online seminar
- Resource booklets
- Video(s)
- Website
- None, I don't want professional development for this
- Other (please specify)

Please select the best time of year for a professional development workshop, short course, or online course from the list below:

- During term time (November-December)
- Summer school holidays (January)
- During term time (February-March)
- Other (please specify)

Please select the best time for a professional development workshop, short course, or online course from the list below:

- School day
- Weekend
- Evening during the week (short/online course only)
- Evening at the weekend (short/online course only)
- Other (please specify)

Is there anything you would like to share that you think has not been addressed by this questionnaire? Please explain here: *(Optional)*

Appendix B: Ethics Approval Documentation

Reporting Sheet for use ONLY for proposals considered at departmental level

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Form Updated: November 2018

UNIVERSITY OF OTAGO HUMAN ETHICS COMMITTEE APPLICATION FORM: CATEGORY B

(Departmental Approval)

Please ensure you are using the latest application form available from: http://www.otago.ac.nz/council/committees/committees/HumanEthicsCommittees.html

1. University of Otago staff member responsible for project:
Davis Lloyd Prof.

2. Department/School:
Centre for Science Communication

3. Contact details of staff member responsible *(always include your email address)*:

Email lloyd.davis@otago.ac.nz
Tel +64 3 479 7654
Centre for Science Communication
University of Otago
133 Union Street East
Dunedin 9016

4. Title of project:

Storytelling for NCEA Science Assessment

5. Indicate type of project and names of other investigators and students:

Student Research	X	**Names**	Mary Rabbidge
Level of Study (e.g. PhD, Masters, Hons)			Masters

6. When will recruitment and data collection commence?

October 14th 2019

When will data collection be completed?

November 11th 2019

7. **Brief description in lay terms of the aim of the project, and outline of the research questions that will be answered** (approx. 200 words)**:**

The first goal of this project is to find out what teachers' attitudes are towards using science and arts NCEA achievement standards to assess students' understanding of science concepts through storytelling. The second is to find out the needs of these teachers for professional development to provide them with the skills to use this form of assessment with their science classes.

The semi-structured interviews will cover the following questions, although the conversation may deviate from this slightly if the responses lead to further relevant questions.

1. What types of tasks do you use for Science assessments? (Prompt: such as written reports, posters)

2. Have you ever assessed more than one standard in a single project?
    a. Are you interested in doing this? Why/why not?
    b. Did you assess standards from different subjects?

3. Are you interested in using creative assessment methods in Science? (Prompt: such as podcasting, visual design, animation)

4. Are you interested in using storytelling for creative assessments in Science?

5. What do you see as barriers to using creative assessments in NCEA?

6. Would you be more likely to use creative assessment tasks if there was PLD available?
    a. Why/why not?

7. What sorts of PLD would be worthwhile for this? (Prompt: such as workshop, resource booklets, assessment tasks)

8. **Brief description of the method.** Include a description of who the participants are, how the participants will be recruited, and what they will be asked to do and how the data will be used and stored.

Participants will be teachers selected by self-nomination using a message on the Science Teachers' Facebook Page. The interviews will be carried out in person where possible, at a time and in a location selected by the interviewee. Where in-person interviews are not possible, they will be carried out over Skype at a time nominated by the interviewee. Interviews will last approximately 20 minutes and will follow the themes of the questions listed above.

Interviews will be recorded on an audio device for transcription and analysis. A summary of the interview and selected quotes will be shown to the interviewee to ensure they accurately reflect the views of the participant. Responses from participants will be analysed to determine the attitudes of teachers towards cross-curricular assessment and their professional development needs. This will be used to inform the design of the creative project for this thesis, a professional development programme for teachers. Data will be kept on a storage device and kept at the Centre for Science Communication for 5 years, after which it will be destroyed. The identities of the participants will not be disclosed.

Reporting Sheet for use ONLY for proposals considered at departmental level

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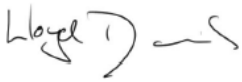
9. **Disclose and discuss any potential problems and how they will be managed**: (For example: medical/legal problems, issues with disclosure, conflict of interest, safety of the researcher, safeguards to participant anonymity if open access to data is proposed etc)

   To protect the safety of the researcher and participants, in-person interviews will be conducted in locations where other people are present (although not part of the interview) such as school classrooms.

***Applicant's Signature:** ....  .....

Name (please print): Lloyd Spencer Davis

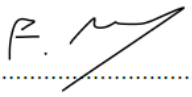
Date: 17 October 2019

**The signatory should be the staff member detailed at Question 1.*

ACTION TAKEN

☑ Approved by HOD ☐ Approved by Departmental Ethics Committee

☐ Referred to UO Human Ethics Committee

Signature of **Head of Department:  Under delegated authority of the HOD

Name of HOD (please print): ....Fabien Medvecky.....

Date: ...17/10/2019.....

**Where the Head of Department is also the Applicant, then an appropriate senior staff member must sign on behalf of the Department or School.

Departmental approval: *I have read this application and believe it to be valid research and ethically sound. I approve the research design. The research proposed in this application is compatible with the University of Otago policies and I give my approval and consent for the application to be forwarded to the University of Otago Human Ethics Committee (to be reported to the next meeting).*

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

Academic Services
Manager, Academic Committees, Mr Gary Witte

D19/272

30 October 2019

Professor L Davis
Centre for Science Communication
133 Union St East

Dear Professor Davis,

I am writing to confirm for you the status of your proposal entitled "**Storytelling for NCEA Science Assessment**", which was originally received on September 17, 2019. The Human Ethics Committee's reference number for this proposal is **D19/272**.

The above application was Category B and had therefore been considered within the Department or School. The outcome was subsequently reviewed by the University of Otago Human Ethics Committee. The outcome of that consideration was that the proposal was approved. Thank you for providing the survey for the record.

Approval is for up to three years from the date of HOD approval. If this project has not been completed within three years of this date, re-approval must be requested. If the nature, consent, location, procedures or personnel of your approved application change, please advise me in writing.

Yours sincerely,

Mr Gary Witte
Manager, Academic Committees
Tel: 479 8256
Email: gary.witte@otago.ac.nz

D19/320
17/10/2019

STORYTELLING FOR NCEA SCIENCE ASSESSMENT FOR PARTICIPANTS

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate, we thank you. If you decide not to take part, there will be no disadvantage to you and we thank you for considering our request.

What is the Aim of the Project?

The aim of this project is to find out teachers' attitudes towards combining NCEA Achievement Standards from science and arts subjects to assess students' understanding of science through storytelling. From this, the goal is to determine teachers' professional development needs to employ this with their learners and develop appropriate resources.
This project is being undertaken as part of the requirements for Mary Rabbidge's Master's of Science Communication.

What Types of Participants are being sought?

Participants will be current teachers of NCEA Science courses in New Zealand. They will be self-selected by responding to a message on the NZ Science Teachers' Facebook Page, indicating their views on creative cross-curricular assessment for NCEA Science courses. Some teachers may also be selected using the snowball sampling approach, in which teachers nominate other teachers who would be suitable for the study. From this, 10-20 teachers will be selected to cover a range of viewpoints on topic and geographical locations throughout the country. Teachers will be given a small koha to thank them for their time. The results from the data analysis of the interviews will be used to develop a free programme of professional development for all New Zealand Science teachers to employ creative assessment methods with their learners.

What will Participants be asked to do?

Should you agree to take part in this project, you will be asked to answer a series of questions about your opinions and experiences of creative and/or cross-curricular science assessment tasks, barriers to employing these methods, and preferences for professional development. The interview should take 20-30 minutes to complete and will be conducted at a time and place that is convenient to you. If an in-person interview is not possible, this will be conducted via Skype or Zoom at a time nominated by you.

Please be aware that you may decide not to take part in the project without any disadvantage to yourself.

What Data or Information will be collected and what use will be made of it?

The interviews will be audio taped for transcription and analysis. No personal information that can be used to identify you will be recorded. The content of the interviews will be analysed to identify themes that arise from the discussions and used to inform the programme of professional development resources that will be made. The student researcher, supervisor, other academic staff at the Centre for Science Communication, and a transcriber may have access to the recordings of the interviews. A summary of the interview and selected quotes to be used in the final thesis will be shown to participants to ensure this is an accurate reflection of their views. The results of this research will be available to participants on request. The programme of professional development will be made available to all Science teachers in New Zealand.

The data collected will be securely stored in such a way that only those mentioned above will be able to gain access to it. Data obtained as a result of the research will be retained for **at least 5 years** in secure storage. Any personal information held on the participants may be destroyed at the completion of the research even though the data derived from the research will, in most cases, be kept for much longer or possibly indefinitely.

No material that could personally identify you will be used in any reports on this study. Results of this research may be published. The data from this project will be publicly archived so that it may be used by other researchers.

The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand) but every attempt will be made to preserve your anonymity.

This project involves a semi-structured questioning technique. The general line of questioning includes the topics listed above. The precise nature of some of the questions that may be asked has not been determined in advance, but will depend on the way in which the interview develops. Consequently, although the Centre for Science Communication is aware of the general areas to be explored in the interview, the Committee has not been able to review some of the precise questions that may be used.

In the event that the line of questioning does develop in such a way that you feel hesitant or uncomfortable you are reminded of your right to decline to answer any particular question(s).

Can Participants change their mind and withdraw from the project?

You may withdraw from participation in the project at any time and without any disadvantage to yourself.

What if Participants have any Questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:-

Mary Rabbidge and *Professor Lloyd Spencer Davis*

Centre for Science Communication Centre for Science Communication

University Telephone Number: +64 3 479 7654

Email Address:

jarma938@student.otago.ac.nz

Email Address:

lloyd.davis@otago.ac.nz

This study has been approved by the Department stated above. However, if you have any concerns about the ethical conduct of the research you may contact the University of Otago Human Ethics Committee through the Human Ethics Committee Administrator (ph +643 479 8256 or email gary.witte@otago.ac.nz). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

STORYTELLING FOR NCEA SCIENCE ASSESSMENT
CONSENT FORM FOR
PARTICIPANTS

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:-

1. My participation in the project is entirely voluntary;

2. I am free to withdraw from the project at any time without any disadvantage;

3. The data from this project will be publicly archived so that it may be used by other researchers, but any information that could identify you will be removed or changed.

4. This project involves a semi-structured questioning technique. The general line of questioning includes teachers' attitudes towards creative cross-curricular assessment, barriers to using these methods, and professional development needs. The precise nature of some of the questions that may be asked has not been determined in advance, but will depend on the way in which the interview develops. Consequently, although the Centre for Science Communication is aware of the general areas to be explored in the interview, the Committee has not been able to review some of the precise questions that may be used.

   In the event that the line of questioning develops in such a way that I feel hesitant or uncomfortable I may decline to answer any particular question(s) and/or may withdraw from the project without any disadvantage of any kind.

5. The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand) but every attempt will be made to preserve my anonymity.

I agree to take part in this project

....
(Signature of participant) (Date)

.....
(Printed Name)

Appendix C: Questionnaire Codebook

Question 1: Are there any other thoughts you have about cross-curricular assessment not listed above? Please list them here:

Issue	Responses	Example Responses	Number of Responses
Workload (n=8)	Experienced or perceived increase in workload: teachers (3); students (2).	"Will most likely increase the workload for the teacher, especially initially"	5
	Experienced or perceived decrease in workload: teachers (1); students (2).	"I have tried and successfully integrated Physics and Music (strange as it may seem!). The Physics students did a AS3.2 (3 credits) research assignment which they handed in. I marked it and then the same piece of work was handed in for Music AS3.10 (6 credits) so they ended up with 9 credits from one piece of work!!"	3
Teacher Issues (n=24)	This category was divided into several subcategories: Time: participants lamented the lack of available time to develop a programme including cross-curricular assessment.	"Never time to allow us to work together."	4
	Preference: these teachers explained their preference for other forms of teaching and learning and/or dislike of cross-curricular assessment.	"I don't see a lot of point of combining the Arts with Science, and when doing cross-curricular tend to stick to STEM, not STEAM. Occasionally work with design/media."	3
	Co-operation: these comments outlined issues with working with other teachers to make cross-curricular assessment successful.	"It seems a huge feat to actually organise and liaise with other areas."	6

	Discomfort: teachers expressed their own or others' perceived lack of comfort, knowledge, or willingness with using cross-curricular assessment.	"some teachers do not feel comfortable learning new standards"	5
	Timetabling: this comment mentioned issues with co-ordinating the school timetable.	"Depends sometimes on your timetable"	1
	Subject integrity: these comments raised issues with subjects maintaining specialist language and knowledge. (Included here as it is highly contested amongst teachers).	"Loss of disciplinary language and integrity is an issue."	2
	Interest: these teachers expressed interest in using cross-curricular assessment and/or storytelling for NCEA science.	"student achievement could potentially be improved if there are fewer assessments done well, so the opportunity for them to get multiple credits for the one piece of work is very appealing"	3
NCEA Restrictions (n=13)	This category was divided into three subcategories: Standard alignment: several teachers noted the difficulties imposed by prescriptive standards for NCEA assessment, that different subjects have very different requirements and weightings.	"Have dabbled with some technology standards, but found it challenging as the technology AS specification were very specific. Made it difficult to get an authentic task ticking all the boxes" "It depends so much on what subject you can go cross-curricular in and having AS that can be assessed PROPERLY in both areas. E.g, Level 1 Physics and Level 1 Maths AS are still a poor fit."	8
	Changes: NCEA was under review at the time this questionnaire was circulated. These	"Will of course depend on the nature of the new standards!"	4

	teachers mentioned the issues they or other teachers may foresee with this.		
	Marking: this comment outlined experienced issues with marking standards from outside a teacher's specialist subject area.	"We had some confusion when the time came to mark the standard. In our case Science teachers marked both the science and maths component, however, although both standards required the same data gathering process, science was worth 4 credits and required more detailed answers, whereas maths was worth 3 credits and required far less rigor and used different language. This unsettled staff and using hindsight better planning will be required to improve the process next time."	1
Student Needs (n=12)	This category was divided into four subcategories: Difficulty: these comments explained teachers' concerns that cross-curricular assessment may be harder for students to excel in.	"Science are looking at reporting of facts and analysis whereas English need to demonstrate some creative thinking. Makes it very hard for all but the extremely able to hit both standards in a sensible time frame."	4
	Outcomes: these comments related to experienced or perceived positive (2) and negative (3) effects on learner outcomes.	"student achievement could potentially be improved if there are fewer assessments done well" "The students in cases where we've looked at this before have said they'd prefer to treat each separately because it's easier for them and will allow them to achieve a higher grade which reflects their ability in each."	5
	Engagement: these comments related to experienced or perceived positive effects on student engagement.	"Allows the learners to focus on their passions, which engages them and deepens their knowledge and links to other areas of learning that they may not have	2

		encountered previously."	
	General: this comment mentioned the importance of considering student voice.	"All for it in response to student"	1
Other (n=3)	These comments related to survey structure and questions.	"It is difficult to comment effectively without more details. The concept is vague (which is ok, as it is a new (ish) concept). But these are quite specific questions, which may give a false sense of certainty when you collate the information."	3

Are there any other barriers to using cross-curricular assessment of science Achievement Standards that are not listed above? Please list them here:

Issue	Responses	Example Comments	Number of responses
Workload (n=4)	These comments all related to an increase or perceived increase in workload for teachers (2) and students (2)	"SMT at my school would support cross curricular assessment but do not understand the teacher workload or subject assessment issues that make this difficult." "Volume of instructions required"	4
Teacher issues (n=31)	This category was divided into the following subcategories: Time: all related to the lack of time available to teachers or the increase in time required to prepare cross-curricular courses and/or assessments.	"As long as time is allocated if 2+ subject areas are combined to allow for skills from both areas are learnt. Planning & collaboration takes more time."	8
	Discomfort: outlined other teachers' perceived lack of confidence with cross-curricular assessment.	"The science learning area has created NCEA standards that are so content-heavy, that it is a very big challenge to find ways to bring that content out in other learning area contexts. Not all teachers have the confidence or experience to do this. That's why it's not common practice."	1
	Co-operation: this subcategory encapsulates both lack of teacher willingness to participate in cross-curricular assessment and difficulties with co-ordinating teachers to work collaboratively for cross-	"Getting other teachers to think outside the square and not approach it negatively." "It would also be challenging to coordinate curriculum timelines across departments to get two departments to work on a shared unit at the same time. "	10

	curricular assessment.		
	Knowledge: teacher's lack of knowledge of subjects other than their specialist area and grade boundaries for assessment.	"Teachers not knowing what is in the standards of other subject areas and how what we teach in Science can be assessed using other the standards of other subject areas."	5
	Support: teachers' needs for support both with implementation of new assessments and subject-specific professional development.	"There seems to be very little subject specific PD in NZ, which as an overseas trained teacher makes it very difficult to find out how NCEA works, let alone how to tackle new assessments."	5
	Subject integrity: concern that specialist knowledge from their subject will be lost.	"In my view, what has always held back this type of assessment is the fact that it does not deliver the depth and rigour of the subject adequately."	1
	Interest: this teacher expressed interest in cross-curricular assessment, on the proviso it could be achieved successfully.	"If you can find ways to do this, that would be wonderful."	1
Student Needs (n=8)	Time: perceived increase in class and homework time to complete assessment tasks.	"Time: preparation, rehearsal, etc. Would this require more class time? would this increase the amount of work needed out of class? How long would it take to perform/mark/moderate?"	1
	Difficulty: concerns that combining tasks will be too difficult for some students and/or may make assessment harder for all students.	"The specific requirements of the current NCEA internal assessment standards for Science (and Maths) are sufficiently specific that it is very difficult to combine assessments with humanities subjects in ways that don't simply double the complexity, and therefore jeopardy, of these assessment for students."	4
	Engagement: issues with students already being disengaged and lacking motivation to complete project independently.	"I suspect that (many of) the people sitting in Wellington and in subject expert groups have been out of the classroom far too long. They think that all students are motivated, naturally inquisitive and wanting to learn! In reality many have other things on their mind! The minute you leave some groups of students they will drift off-task. The NZQA and NCEA "is it worth credits" issue we have now means many students are unwilling to explore something they won't be directly rewarded for. Sad state of affairs."	1
	Preference: students may not want to combine subjects and their course selection may not allow	"student course selection"	2

	for it.		
NCEA restrictions (n=6)	Standard alignment: issues with co-ordinating requirements and grade boundaries for standards from different subject while maintaining meaningful learning.	"Hitting the requirements of standards from different subject areas. Often, at first sight it can look viable, but to do justice to the standards can take an awful lot of work and sophisticated thinking from the student."	4
	Changes: lack of certainty about future standards adds difficulty and reluctance for teachers.	"Potential barrier with changes to NCEA from 2021"	2
School Issues (n=10)	Finance: may be expensive to run cross-curricular programmes.	"financial constraints could be an issue."	2
	Timetabling: difficulties co-ordinating year and week plans to combine subjects.	"It would also be challenging to coordinate curriculum timelines across departments to get two departments to work on a shared unit at the same time."	6
	Department co-operation: difficult to get a whole department and more than one department working together.	"Finding an online space to work co-operatively with other curriculum areas is difficult with all of the meetings happening each day. This is a huge barrier for us at Te Kura, it's not that we don't want to do this, it is just that there are regional considerations, national groups (curriculum areas), local meetings (smaller offices within regions)."	2
Other (n=2)	Parents: may be concerned that cross-curricular learning is too different from what they did at school.	"You haven't asked about parents - often they are sceptical because it is not how they learned, or they are concerned about specific requirements, such as UE"	1
	Survey: issue with survey design.	"Again, specifics limit the validity of the answers."	1

Is there anything you would like to share that you think has not been addressed by this questionnaire?

Issue	Responses	Example Comments	Number of responses
Professional Development (PD) (n=15)	This category was divided into the following subcategories: Timing: suggestions for the best time for running a professional development workshop.	"It is important to give pd on this BEFORE the year gets underway. I am more than happy to use holiday time or after seniors go or evenings to reduce the impact on not being with my seniors. I do a lot of my planning in January so Feb-March is too late."	4

	Issues: concerns with attending professional development, including cost to school and/or accessibility for teachers in isolated locations.	"It is so hard to have PD when we are in regional areas."	4
	Support: need for support of teachers including follow-up after workshop.	"Offering follow up support and guidance to ensure teachers participating are able to develop their own resources"	5
	Resources: desire for resources to be provided and/or developed during workshop/course	"I think it's a great idea but unless the course leaves teachers with a ready to use resource then I would be unlikely to implement anything even after attending the course. It would be great if a resource was also made for use in year 10, because then we can practice and get used to it but without jeopardising our seniors' grades."	2
Teacher issues (n=15)	This category was divided into the following subcategories: Time: amount of time needed to prepare resources and/or attend PD.	"And teachers give up enough time, so this should really be run during school time if possible"	2
	Co-operation: both positive and negative statements relating to need to collaborate with other teachers.	"I am already a confident use of digital technologies and consider myself digitally fluent. I would prefer to experience this kind of PLD with colleagues who are ready to try something new and innovative so we can share any new learning together"	3
	Discomfort: personal difficulty with arts content.	"My dysgraphia means I don't bring any existing strength in story telling; the opposite, in fact (I won't be the only science teacher like this). For this I am, therefore, dependent on a) the collaboration of the humanities teacher whose standard would be co-assessed (fortunately, I have a humanities teacher who is interested in this), and b) learning a framework for this as part of the PD."	1
	Technology: teacher competence with use of technology and/or issues with student behaviour with technology.	"You didn't give people the option if they were already using a variety of technologies in their classes!!" "The use of technology needs to be discussed as, in my case, whenever I assign an e-learning activity, I still have students go off task as it is difficult to monitor them."	4

	Implementation: need for support from middle and senior management to establish cross-curricular assessment in school.	"This would most likely need to be driven by HOD's to help coordinate and facilitate new curriculum development and integration, and/or from Senior Management giving time and direction for the HOD's."	5
General comments (n=4)	Survey issues: one school did not fit the categories provided; one teacher took issue with combining cross-curricular assessment and storytelling in the questions.	"I'm very confused. Is cross curricula assessment and assessing using storytelling the same thing - I get that impression from your survey. Surely they are two totally different things."	2
	No: respondents merely wrote "no" in reply to the question.		2

Appendix D: Interview Schedule

Warm-up:

Can you tell me a bit about your school?
How long have you been there?
What subject areas have you taught?

Interview:

1. What types of tasks do you use for science assessments? (Prompt: such as written reports, posters)

2. Have you ever assessed more than one standard in a single project?
    a. Are you interested in doing this? Why/why not?
    b. Did you assess standards from different subjects?

3. Are you interested in using creative assessment methods in science? (Prompt: such as podcasting, visual design, animation)

4. Are you interested in using storytelling for creative assessments in science?

5. What do you see as barriers to using creative assessments in NCEA?

6. Would you be more likely to use creative assessment tasks if there was PLD available?
    a. Why/why not?

7. What sorts of PLD would be worthwhile for this? (Prompt: such as workshop, resource booklets, assessment tasks)

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